the glass industry

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Brockway's Moment of Fifty Years

By GLENN A. MENGLE, President

Brockway Glass Company, Inc., Brockway, Pa.

Arrayed along the walls of our general office reception room in Brockway is a collection of glass makers craftsmanship embodying the work of perhaps two centuries. Late one afternoon last winter, upon entering the front door, I was accosted by bright beams of setting sunlight directed at me by way of a squat green bottle, part of the collection.

Closer inspection of the offender revealed that here was a sparkling example of the ageless quality of glass . . . of why it never really grows old.

This particular bottle would be quite "at home" in a present-day dining room. It could just as well have graced the richly provisioned table of Caesar Augustus. We think it was made about 100 years ago, but there is no sure way of knowing. It might very well go back three or four hundred years or even further. For this is the nature of glass. Its chemical inertness defies time. And, we have the most reliable proof ever offered to support this claim. It consists of a continuous test begun perhaps ten thousand years ago.

Glenn A. Mengle

Nobody knows who really discovered glass. Glass containers were in use at the time of the Sumerians, the earliest known civilization. In fact, fragments of hand made, strand wound glass have been found in excavations which predate the recording of history. This glass has basically the same chemistry as that used today.

Through the succeeding few thousand years glass bottles were always laboriously hand blown, the objective being usually more artistic than practical. Quite often the craftsman would patiently create vials and bottles of intricate design that displayed delicate grace and beauty which has since never been copied. The average middle class family could perhaps afford two or three common, unornamented bottles for storing staples.

Wealthier land owners cherished skillfully crafted, ornate bottles as prized treasures—the glass often blown to the thickness of parchment. Few of these pieces remain intact today for obvious reasons.

Glass containers comprised the first export shipment ever made from America. The demand for bottles had become so heavy in early seventeenth century England that bottlemakers looked to the new colony of Virginia for new production capacity.

In 1608, eight Dutch and Polish glass blowers were sent to the ill fated colony at Jamestown. They built America's first factory and began turning out crude drinking glasses and bottles for the settlers and for exportation. In addition, a sizable segment of production was devoted to beads for various transactions with the local Indian population.

The first ship returning to England carried a cargo of glass containers. They were hand blown, of course, and rather crude by today's standards. Certainly though, they were as high in quality as those being made in the mother country. The slow rate of production coupled with high shipping costs made the selling price of these containers extremely high. But then, demand far outweighed supply at the time, and England was enjoying one of the most prosperous periods in her history.

While the succeeding three hundred years produced some improvement in quality, nothing significant occurred to alter the per unit production rate or the price. It was the beginning of the twentieth century before glass bottles could be turned out in quantities that would place the per dozen purchase price within reach of everyone.

THE ADVENT OF MACHINE BOTTLE MAKING

With glass making occupying such a broad span of time, the fifty years herein recorded are simply an instant. Yet, they make up the most vitally important instant in the history of this remarkably versatile material.

Take the modern feeding devices and the adjustable cams from the machines we use today, and you have the basic machine that replaced powerful lungs with a mold

Plant purchased by the twelve glassworkers and two grocers from Olean, New York. The plant, located in Brockwayville, Pennsylvania (name changed to Brockway in 1925) was formerly operated by a hand-blown glass company.

and a tank of compressed air. The whole Brockway story, the whole bottle-making industry story, is one of machines, the men who built them and built with them.

Bottle forming machines were undoubtedly feared and verbally condemned by glass blowers at the beginning. It was, however, the original semi-automatic bottle machines that saved the bottle maker from ultimate extinction. Hand blowing methods just could not have kept up with the rapidly growing container industry. The high price of their ware would have wiped them out.

It was one of these machines that brought the present Brockway Glass Company into being. Originally named The Brockway Machine Bottle Company, it began in Olean, New York at a meeting of twelve glass workers who had cut their teeth on one of the first semi-automatic bottle forming machines. The "Olean Machine", as it was to become known, was never patented. There was nothing to prevent these ambitious men from building one of their own and turning out glass bottles by their own company.

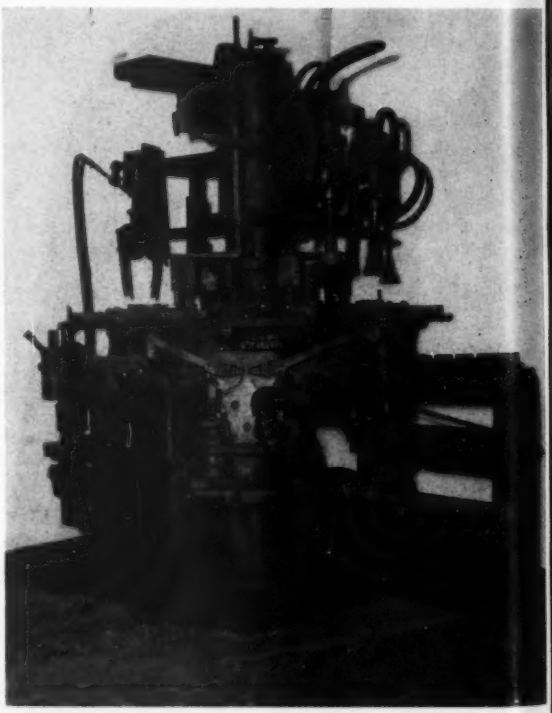
To bolster the cash they could raise among themselves, the founders brought into their corporation two partners in an Olean grocery firm. Altogether, they raised $34,000. It is a sizable sum of money now. It was a lot more then. While the infant company was later to know the frustrations of tight money supply, the starting amount was evidently enough.

These were production men. They knew how to make fine quality bottles, millions of them per week if necessary. That was what mattered. If they were shy on some of the finer points of finance and business management, it does not appear to have hurt them.

Upon receipt of an inducement of $1000 from the people of a town in northwestern Pennsylvania then called Brockwayville, the directors decided to purchase an already existing glass plant there and start production. Seven of them arrived by train on a sweltering Friday, the day after the Fourth of July in 1907. They were to ready the plant for operation while the others closed out final details in Olean. The first bottle, a vaseline style bottle by the way, was pressed, blown and annealed on Tuesday, October 14, 1907.

They built the machines, the tanks, the lehrs and later on the feeder mechanism that was to make bottle machines fully automatic. Before the development of the feeder, each gob of glass was hand gathered from the "glory hole", then cut off with a pair of tailor's scissors by the presser. The presser, who came by his name through being responsible for operating the compressed air lever was indeed a very busy man. He had to estimate the exact quantity of gob needed, cut it off, drop it into the blank mold, press the blank, move it to the blow mold with tongs, then pull the precise amount of compressed air into the mold. Pressers were quick men. It was a tiresome job. With the feeder it became possible to automatically adjust weight while feeding the molten glass to the machine in exact quantities required for any given bottle design.

Brockway is credited with the invention of one of the first, if not the first practical feeder mechanisms in the

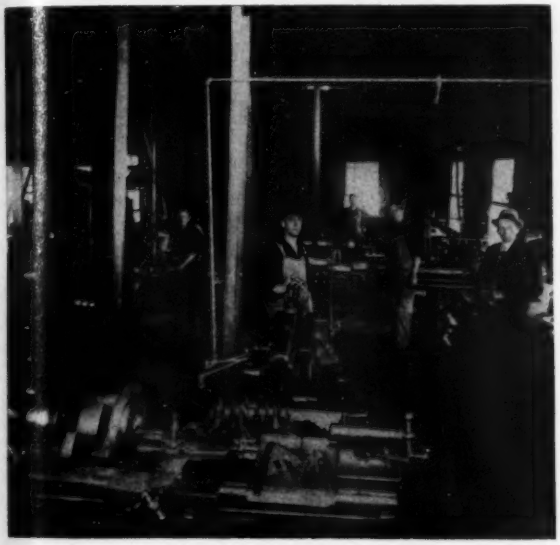


One of the early "Brockway" machines. This machine included the feeder device (not shown) developed at Brockway and a turntable. The result was a fully automatic glass forming machine.

industry. It was designed and built by the twelve founders. The feeder was first tried on the company's seven Olean machines, but it was found that a new machine design would be required to fully accommodate the radically new method.

Thus came about fully automatic bottle forming at Brockway. The machine, named the "Brockway", was equipped with automatic feeding and a turntable device. The turntable greatly increased production and eliminated the necessity of moving the half-formed bottle from blank mold to blow mold with tongs.

Feeders and turntables are today integral parts of bottle making machines, and it is difficult to visualize how the equipment could have operated without them. There are many other improvements, of course. In fact, the manufacturers of Brockway's present day machines are sometimes startled at how we fit modern equipment to our needs. Brockway engineers make many modifications on each machine before putting it into production. It is a matter of deep pride at Brockway that we have production plants as modern and well equipped as can be found anywhere throughout the industry.



View of the mold shop at Brockway Machine Bottle Company in 1908.

Glass making has indeed undergone tremendous changes in the past fifty years. The growth we have seen would have staggered the imagination of the men who started it all. The very top production rate for one machine in 1907 was about a dozen per minute. Today a machine can comfortably turn out well over one hundred in the same time. We have, admittedly, certain things in our favor. We have better engineering and technology today, and we have more highly developed skills. Many new markets have been created which simply did not exist at the turn of the century. We have better facilities with which to work.

Communication, for example, was extremely difficult and circuitous at Brockway in 1907. There was one telephone in the plant, useful only for a limited number of local calls. Electric power was available . . . if you had generating equipment and a power source to run the generator. The entire Brockway plant was originally

The Brockway plant in 1929. The gabled frame building with the pillars is the company's first office building. It was used from the beginning in 1907, but has since been torn down.

powered with one small fifty horsepower gasoline engine.

Gaslight was used for illumination at first. Later, in 1910, the company purchased a 2-cylinder Struthers Wells gasoline engine and a generator to provide electric lighting. Bottle forming machines and all other equipment were still belt driven from the one 50 horsepower engine.

This fifty horsepower engine was extremely hard to start. Seemingly endless cranking and manipulation was required, and consequently the motor was never purposely shut off.

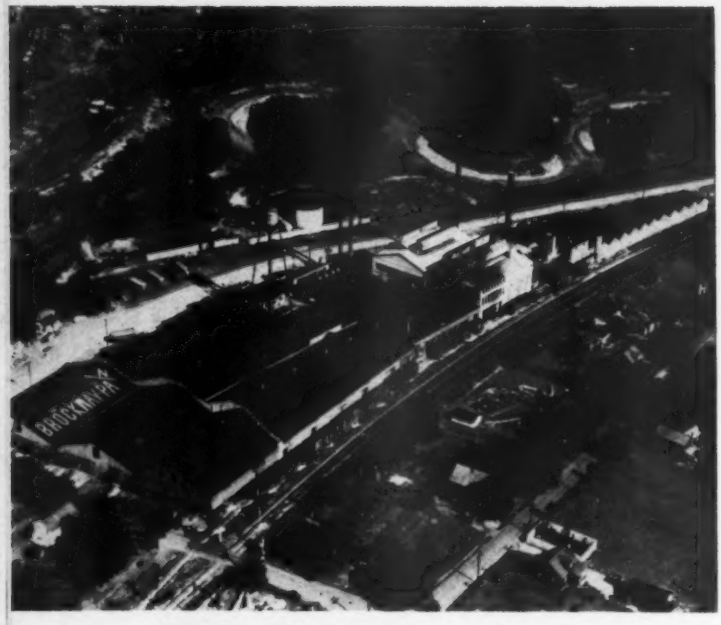
It had, however, a rather cooperative habit of forecasting a stall or breakdown by slowing gradually rather than stopping abruptly. Accordingly a minor stampede took place in the plant each time the engine signaled an impending stoppage. It is reported that this engine under full power could be heard within a half mile radius of the plant.

In 1913, steam generators were installed to furnish power, replacing the erratic though apparently indestructible 50 horsepower engine. The new generators, however, did have their drawbacks. The DC current was short on providing consistent speed and on cold nights the machines would slow down, but the generators were the principal source of power for many years.

World War I found the glass industry in a very vital, if somewhat indirect position to make itself highly useful. The basic raw materials of many industries become instantly critical at the outbreak of war, but not so the glass industry. Sand, limestone and soda ash are not normally too hard to come by. Consequently, glass was able to relieve serious shortages of other materials and provide the armed forces, the nation's industries, and our homes with the necessary quality containers.

By 1922, everything was back to normal at the plant. The preceding four years had each seen very substantial growth in volume, and the company's first Lynch B type machine was purchased to supplement production of a growing line of small ware.

Within three years a Lynch A and a Miller machine were purchased to broaden the line even further. However, the bottle machine situation, up-to-date though it was, pointed up an increasingly evident production and sales limitation. Brockway was making, for the most part, wide mouth ware.



View of the present plant #1 at Brockway.

While all of its equipment, including Brockway machines, the Miller and Lynch A and B machines that had been continually improved, only the Lynch A and B machines were available to manufacture narrow neck bottles. Ink bottles, salve jars and similar ware comprised the major part of the line.

Brockway obviously was not having any difficulty with sales volume. It was growing steadily, but the handwriting on the wall was clearly visible. The narrow neck bottle field was an enticing plum. However, vastly different distribution problems in relation to narrow neck ware sales necessitated a distinctly separate sales organization.

For this reason, the Brockway Sales Company began operation in 1927. It purchased the parent plant's entire production of narrow neck containers and sold it through greatly broadened sales channels.

As soon as the sales company began functioning smoothly, sales offices were opened in the important trading centers east of Chicago. The backlog of orders stimulated an agreement with Monaca Glass Company (founded in 1929) to purchase the limit of their production.

Plant #2 at Cranshaw, near Brockway, today.

At the time of the bank holiday in 1933 Brockway Machine Bottle Company purchased the assets of Monaca Glass and operated their plant for almost a year. In August of the same year, Brockway Glass Company came into being through the merger of Brockway Sales Company with Brockway Machine Bottle Company.

A source of incredulity to many businessmen who endured the depression is that Brockway continued to make money consistently during that period. Though profits were off sales climbed. Two factors accounted for this departure from the plunging business cycle. First of all, the repeal of the 18th Amendment in 1933 generated a lusty demand for beer, wine and liquor bottles. At the same time it spelled the end of a profitable trade for a number of our fellow bottle makers in foreign countries.

The second specific stimulant to Brockway was the company's progressive sales policy. The company embarked on a sound but lively and vibrant program. With the new equipment and increased production capacity, they were able to raise enthusiastic sights, invade new lines, seek out and penetrate new markets. It was at this time the company achieved its position in the narrow neck food, proprietary and pharmaceutical field.

The ability to sell these new markets lay in part with the production facilities at Brockway. Purchasers wanted

The newest Brockway Glass Company plant at Freehold, New Jersey.

to be sure of a continuing source of supply. And while Brockway was not the largest in the field from an overall volume standpoint, quality was unexcelled. The fastest, most modern plant consistent with that quality was capable of handling the demand. Such has always been the case.

Brockway's ability to make such a wide variety of ware, always of top quality, is basically responsible for our progress. First rate equipment and facilities had continually been a creed at Brockway. Only the best, most up-to-date machines available were purchased.

As volume continued to grow, it became evident that new plant capacity would soon be needed. In 1939, plans were drawn for Plant #2 in Brockway. Beginning operations in 1941, the new plant fully lived up to the production efficiency planned for it. It is still one of the best, most modern and smooth flowing plants in the industry.

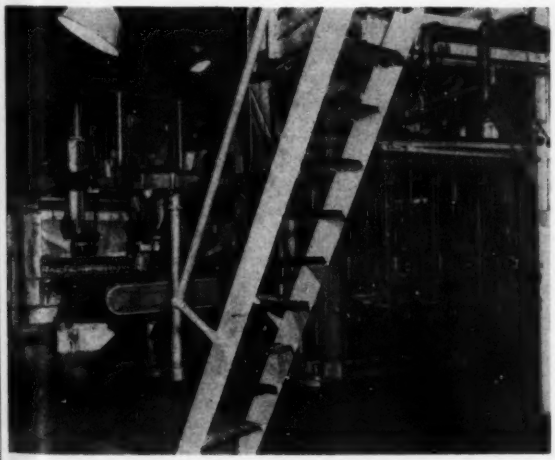
Like the rest of the container industry, a very substantial part of our shipments during World War II were

devoted to bottles for food and medicines consigned to military establishments. The Army, Marine Corps, Navy and Air Force are still very good customers. But, as in World War I, an effort was made to avoid the necessity of restricting customers. More food than ever before was being packed in glass at that time, and demand skyrocketed during the apprehensive years of '42, '43 and '44 when steel was all but shut off to manufacturers of other types of containers. It was our practice at that time to treat all customers equitably. As would be suspected, it was a wise policy.

After the fall of 1945, orders from all markets increased tremendously, particularly in the food lines. Here, during the war, glass container manufacturers were able to serve the dual role of providing food containers for the nation, and proving the durability, visibility and chemical inertness of glass for the first time to many previously doubtful food processors.

Resulting from this great increase in demand, the post war years have been for Brockway, an era of wholesale plant expansion. In May of 1946, plant #3 at Muskogee, Oklahoma began operation, and in 1947, ground was broken for a large addition to Plant #2 at Brockway. In order to supply the demand for food containers while the new section of Plant #2 was under construction, the H. J. Heinz Company plant in Sharpsburg, Pa. was purchased. It was sold the following year when the new Brockway addition was completed and in production. The old Sterling Glass Plant at Lapel, Indiana was purchased in 1950, and following complete modernization, was put into operation the following year.

As must be obvious, there was more afoot in these plant purchases than simply expansion. Market centers for containers are often located hundreds of miles from each other. Although carrying widely varying lines affords more numerous market potentials, cost efficiency demands that the location of plants manufacturing any one line be as close to their respective market centers as possible. Naturally, Brockway plants manufacture more than one line, but the lines they do manufacture are carefully balanced costwise, against freight rates. For these and other reasons, the post war Brockway expansion has been as much a solution to decentralization needs as to demands for more production.

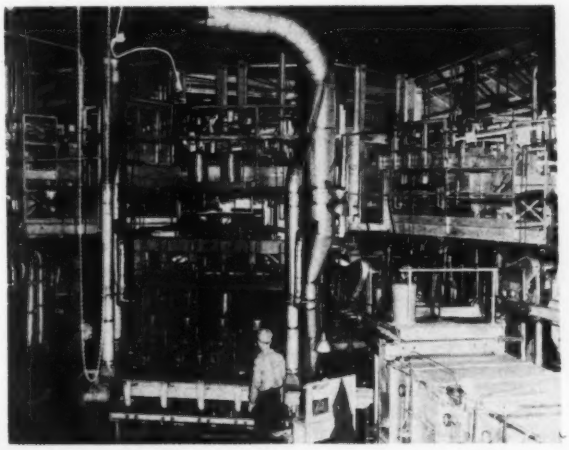


End view of one of the company's IS, five-section bottle forming machines, showing stacker and lehr.

An example of the diversity of Brockway's container ware.

The only exception to the multiple ware production at Brockway plants is the Demuth Glass Company plant at Parkersburg, West Virginia. Purchased November 1, 1955, this operation specializes in quality glass tubing for the pharmaceutical trade.

The latest step taken toward better production and distribution is the new Brockway plant at Freehold, New Jersey. It is expected to step up production by 20%, and



Part of plant #1 showing integrated layout of bottle forming machines, with lehr and other associated equipment.

is capable of producing 180 tons of flint glass containers daily. Highly exacting standards of quality control have been given a boost at Freehold with a number of new innovations in raw materials sampling and mixing.

Brockway laid the foundations for surface coatings, and modern equipment for this process is available at all our plants. The section devoted to coatings at Freehold, however, is equipped to take maximum advantage of the most up-to-date procedures related to increasing the strength and durability of glass containers.

Another aid to plant efficiency as well as product quality at Freehold is the installation of straight line inspection techniques. The demands of proper and complete inspection are the only criteria. The system permits a

(*Continued on page 284*)

Unusual Sources of Alumina in Glass Manufacture

By R. W. HOPKINS
The Calumite Co., Hamilton, Ohio

The oxide of alumina is one of the most abundant and prevalent chemicals to be found in the minerals composing our earth, approximately 8 per cent of the total. The chances are good that even the soil in your own backyard contains from three to 30 per cent Al_2O_3. This may account, in part, for the fact that the sale of this commodity to the glass industry is so competitive.

Locating aluminum oxide in a state usable for glass or in a state which will lend itself to successful and economical processing is a most difficult assignment for it is firmly bonded with other elements often considered impurities in glass. Of course, one can back a truck up to any hillside and fill it in a short while with a high aluminum oxide mineral—but the chances are good that it would be undesirable and unfit for any use.

Generally, the high alumina bearing minerals are quite refractory and although many are used in glass manufacture, they must be beneficiated and processed specifically for good glass manufacture. Paradoxically, alumina appears to be the key element in the manufacture of refractories for housing molten glass and for various parts comprising the glass furnace structure. This is not unusual since Al_2O_3 contributes refractory qualities to the glass itself in the sense that its use increases the glass durability and resistance to weathering.

In this discourse, we are asked to look into the future of new sources of Al_2O_3 for the glass industry and we propose to discuss several minerals that may offer possibilities of supply or may be even now used to a limited extent.

Perlite

One of the intriguing minerals that may be developed into value some time in the future is "perlite". This term refers to any naturally occurring glass of igneous origin that will expand when either slowly or quickly heated to yield a lightweight product.

Following are the analyses of four of the more common volcanic glasses.

	Perlite	Andesitic Welded Tuff	Pitchstone	Obsidian
SiO_2	65.13	73.29	70.19	73.84
Al_2O_3	15.73	12.63	12.37	13.00
Fe_2O_3	2.24	.84	1.45	1.82
FeO	1.86	2.25	.81	.79
FeS_2	—	—	—	.02
TiO_2	.58	.40	.07	.14
CaO	3.62	1.78	1.43	1.52
MgO	1.49	.10	.91	.49
Na_2O	2.93	3.32	3.03	3.82
K_2O	3.96	5.16	3.57	3.92
MnO	tr	—	.02	.07
P_2O_5	.23	.14	.03	.01
HiO	.07	—	—	—
H_2O	2.43	.34	6.48	.53

It is readily seen that these minerals are, in reality, high silica, high alumina glasses. Although not in correct proportions, all of the essential ingredients are present, and in addition some detrimental components appear.

The volcanic glasses may occur free of crystalline material but most contain either microscopic or large crystalites, or may be fully devitrified. The latter usually takes place because of the slow rate of cooling, governed by variations in the presence of water since many deposits occur in conjunction with hot springs. The glass itself may show a variety of characteristics depending in part upon its actual water content and its eruption history. It may range through all shades from black to nearly white. It may be red, green, or brown but rarely blue. Some dense varieties, such as obsidian, break with conchoidal fracture.

Most volcanic glasses do not have a grained structure. The exception to this is "welded tuff" which has been formed by the compression of small fragments into a solid mass. All those glasses are products of igneous processes within the crust of the earth and with possible rare exceptions are not products of any environmental effect subsequent to eruption.

Unfortunately, all of the perlite volcanic glasses are found from Colorado west, many deposits being located in California. Although almost 15 per cent of the glass container industry is now located on the west coast, the problem of transportation to the midwest would make it appear ill-advised to consider these at the present time. However with the population slowly migrating westward, the glass industry will eventually follow, improving the economic picture. As the high-aluminum sands of California, which are discussed later, are depleted, the volcanic glass minerals may appreciate in value sooner than realized, particularly with new ingenious methods of beneficiation being developed. These glasses contain too many elements of value to the glass manufacturer to be overlooked. Extensive deposits are now being worked for the purpose of manufacturing of light weight aggregate and insulating materials.

Sand

Perhaps the least exploited source of alumina having a good potential for the glass industry is sand. This commodity, of course, is used by the glass industry in tremendous quantities but most of the popular high qual-

Presented at the Annual Meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers in New Orleans, February, 1957.

ity sands are quite low in alumina, ranging .01 per cent to .07 per cent Al_2O_3. This is to be expected since sands of high purity are required in the production of high quality glass and alumina is considered a contaminant along with iron and titanium. Usually these three oxides range together, all being low in purer sands and high in lower grade sands.

The exception to this is found in the feldspar bearing sands, mostly in California. The Del Monte deposit located on the Monterrey Peninsula half way between San Francisco and Los Angeles is an excellent example. By the application of flotation processing, this sand has the resulting analysis:

SiO_2	70.45 per cent
Al_2O_3	18.30
Fe_2O_3	.03
CaO	2.60
Alkalies	8.50

Near Corona, California, a sedimentary deposit is now being mined which is a mixture of quartz, feldspar, mica, and clay. After washing, classifying, grinding, scrubbing, drying, and high intensity magnetic separation, a glass sand is obtained. The average analysis is as follows:

SiO_2	93.0 per cent
Al_2O_3	4.0
Fe_2O_3	.035
Alkalies	3.0

These sands naturally supply sufficient Al_2O_3 in the finished glass to make any additional supply unnecessary and, as a matter of fact, the alumina is much higher in the finished glass than customarily used. For this reason, the west coast users find it necessary to elevate the alkali in order to obtain desired glass viscosities. There are unquestionably many more high alumina sand deposits in the California area and it is understood that recently a large new one has been developed near San Francisco to supplement the Del Monte supply which is nearing exhaustion.

Moving further east, we find that the Kansas River carries a large volume of feldspar bearing sand. This has only recently been processed so as to be suitable for glass manufacture in the Kansas City area. Apparently, extensive feldspar and silica deposits line the Kansas River and it is believed that many opportunities are available for expanding production, providing proper beneficiation methods are used. The present Kansas River sand bears the following average analysis after screening, drying and high intensity magnetic separation. No flotation processes are at present being used.

SiO_2	87.0 per cent
Al_2O_3	7.0
Fe_2O_3	.26
CaO	.6
MgO	.1
Alkalies	4.8

It is not uncommon for many river sands to be quite high in alumina. In the midwest, although the river sands are not usually feldspar bearing, many do carry silts and clays which provide high alumina contents. The normal river sand is much too coarse for use in glass making and many experiments have ended in failure. However, with transportation becoming so much more of an economic factor, we look for extensive exploitation in the future.

The dune sands of Lake Michigan in northern Indiana and Michigan itself will offer someone an interesting study in a new source of alumina. Although these sands are relatively high in iron, it is believed they will lend themselves to processing such as flotation, magnetic separation, etc. An alumina content of three to four per cent is sufficiently high to make them worthy of more research.

It should be here stated that the glass industry is in need of additional and more economical sources of silica as well as alumina and for this reason, the importance of feldspar and clay bearing sands is stressed.

Aluminum Hydrate

In the production of very fine premium type of crystal glassware, aluminum hydrate is usually the chief source of alumina. This is a fine white crystalline product with the chemical formula $Al(OH)_3$. Actual analysis is as follows:

Al_2O_3	64.8 per cent
SiO_2	.01
Fe_2O_3	.003

Because of its high melting characteristics, it is of particular importance that the sizing be quite fine and that it be well dispersed in the glass batch. Whereas most raw materials used in glass manufacture vary from 16 mesh finer, aluminum hydrate carries the following specifications.

on	100	mesh	.6	per cent	max.
"	200	"	8.0	"	"
"	325	"	40.0	"	"

Up until the late 1920's this product was used almost universally as an alumina source in the industry. However, its cost in the high alumina container and flat glasses now restricts its use to those mentioned above.

Bauxite

The parent mineral of aluminum hydrate is bauxite found in several locations domestically, mainly in Missouri and Arkansas. It is not too unreasonable to believe that this is potentially an excellent source of alumina for glass. Ranging from 54 to 61 per cent Al_2O_3, it contains about 30 per cent water and 1 to 5 per cent iron. It is non-plastic, however, and lends itself to processing. Much of the iron is present in a magnetic state making upgrading feasible. It is quite likely that this mineral holds good possibilities as an alumina source for glass in the future.

Clay

While clay is an all inclusive term, certain types of this mineral are now being used as alumina sources and they may offer the chief threat to many presently used products as one of large alumina sources for glass in the years ahead.

It is a product of decomposition and alteration of feldspathic rocks and consists of a mixture of particles of

widely differing chemical and mineralogical properties. Clays are classified as residual and secondary, according to their geological history. Residual clays are those occurring in the same location as originally formed by weathering, while secondary clays are those transportated by water, ice, or wind, and redeposited, alteration usually occurring during the process of transportation.

Of particular import to the glass industry is kaolin, one of the many clays. A typical kaolin used in glass manufacture might analyze:

SiO_2	45.0 per cent
Al_2O_3	39.0
Fe_2O_3	.27

Because of the high melting characteristics of this product even more rigid sizing specifications to those used on aluminum hydrate are enforced; all particles must pass 325 mesh. Strict precautions to assure thorough and complete dryness must be taken in order to prevent lumping or balling into a conglomerate.

Most of the kaolins suitable for use in glass are found in North and South Carolina, Alabama, and Georgia; however, it is very interesting to note that there exists, in Central Virginia, an only partially weathered spar which is commonly referred to as clay. Government surveys show this deposit to be quite extensive, covering some 40 to 50 acres in depths of 5 to 35 feet. While the silica and alumina are somewhat lower than normal kaolin, the latter ranging from 18 to 30 per cent, this material contains valuable alkalies in amounts of 5 to 12 per cent. Undoubtedly some enterprising engineer will make practical application of this deposit in the future, perhaps as a raw material for glass.

The Kyanite Group

Closely associated with the clays and potentially an alumina source for glass are the minerals kyanite, sillimanite, and andalusite. These are aluminum silicates ($Al_2O_3 \cdot SiO_2$) having approximately the same chemical composition but differing in crystalline structure. Kyanite would appear to offer the most promising possibilities because andalusite is found mainly in California and Nevada where alumina compounds for glass are so abundant. The needle-like crystalline structure of sillimanite presents complex processing difficulties.

Kyanite is found in large quantities in Virginia, North Carolina and Georgia with outcroppings reported in several western states. It is easily recognizable because it is one of the few blue minerals. In addition, it has long thin blade-like crystals. While the main usage of this mineral is in the refractory industry, claims are made for its use in glass, especially where low alkali is desirable. A typical analysis of kyanite follows:

SiO_2	37.70 per cent
Al_2O_3	58.77
Fe_2O_3	0.85
TiO_2	1.30
Alkali	0.50

Because of its high melting point (1800°+C) this material would have to be quite fine in particle size (all passing 325 mesh) and very dry to fulfill the requirements of the glass industry.

Topaz

A mineral not being used by the glass industry but which could be of good value to the industry in a dual role is topaz. We ordinarily think of this mineral as a precious gem but it also carries a composition of aluminum fluorosilicate ($Al_2 F_2 SiO_4$). Whereas practically all glasses use specific materials as aluminum sources, most also use fluorine. This element provides lower viscosities at high temperatures and thereby aids in fining.

Topaz may be colorless, but is more often some shade of yellow, and at times brown or even blue. This mineral, as is true of most minerals containing fluoride, is one of those which have crystallized out from hot vapors, escaping from igneous reactions. It is ordinarily found in cavities or seams in or near granite deposits.

It would appear that this mineral could command exceedingly good prices as a glass raw material because of both the alumina and fluorine content. Incidentally, perfect topaz crystals are rare and are considered "gems" and readily marketable in the jewelry industry. Topaz deposits have been reported domestically in Connecticut, New Hampshire, North Carolina, Utah and other states.

Cryolite

Another alumina fluorine bearing mineral is cryolite. It is now being used by the industry, mainly in the manufacture of opal glasses. Having the formula Na_3AlF_6, all three elements that make up its structure are of marked value to glass.

Cryolite is a relatively soft mineral, colorless to very white. The principal source is Greenland but deposits are to be found in Colorado.

Anorthite

A mineral that could become very important in the glass picture of the future is anorthite, calcium aluminum silicate ($Ca Al_2 Si_2O_8$). This is of the feldspar family and is usually found in conjunction with albite, a sodium aluminum silicate. As a matter of fact, it is classified in the triclinic feldspar group which includes a number of minerals ranging in composition from 100 per cent albite to 100 per cent anorthite.

The latter mineral has never been considered seriously by the glass industry because of a combination of two reasons: (1) the location of its deposits and (2) the fact that the calcium is not nearly as valuable to the industry as are the alkalies, sodium and potassium. It therefore cannot command the price of feldspar. This fact has retarded the development of this mineral. However, with the passing of time, it is felt that certain manufacturers in the glass industry advantageously located will find economical advantages. Of igneous origin, worthwhile deposits are found in upper New York State and New Jersey.

Anorthosite

While discussing the calcium-aluminum-silicates as sources of alumina for glass, it would be only proper to take recognition of an important feldspathic rock, found in New York State's Adirondack Mountains and in the State of Wyoming.

The deposits in New York are particularly vast in quan-

tity, there being literally mountains of anorthosite awaiting commercial development. It is a rock made up almost entirely of the mineral labradorite (Na Ca) Al Si_3O_8). Unfortunately it is generally accompanied by high iron impurities but apparently is conducive to magnetic separation.

A typical analysis of anorthosite is as follows:

SiO_2	53.21 per cent
Al_2O_3	26.64
Fe_2O_3	1.35
CaO	11.48
MgO	1.16
Alkalies	5.58

The high alumina value of this mineral would surely indicate its value to be quite good in the glass market. Other components such as calcium oxide and alkalies also add to the value. Of course, Fe_2O_3 values would have to be reduced to .15 per cent and lower in order to find large glass markets. It would appear that a ready market would be available in ceramic fields such as bodies and glazes.

Blast Furnace Slag

Although not a natural raw material, of particular importance to the glass industry during the past 12 years has been the use of blast furnace slag as a source of alumina, calcium, and magnesia.

The idea of using slag in glass originated in Germany during the 1920's and according to the record, it was used in that country for some years, in limited quantities in amber glasses. Although many experimental melts were made in various universities, slag was not used in glass manufacture on a commercial scale, in the United States, until about 1936. Its usage was again limited until 1944 whereupon a company undertook the task of beneficiating it into a material that could be used in quite high quantities in the glass. The upgraded slag is now marketed as Calumite, from calcium-aluminum-silicate and today is used in approximately 90 per cent of the amber glass in this country as well as quite a few of the green and blue glasses.

Slag has the advantage of being strategically located near the heart of the glass industry, holding transportation costs to a minimum.

By application of some basic chemistry and by unlocking some of the secrets contained in the periodic table, many of the components in Calumite which were thought to be undesirable have actually been converted into advantages. Quantities sufficiently high to fulfill the entire lime requirements of the glass are now being used.

Either acid or basic slag is satisfactory as a starter but it is essential that a source be chosen that runs uniform in composition. Typical analysis of Calumite is as follows:

SiO_2	39.0 per cent
Al_2O_3	10.0
Fe_2O_3	.3
CaO	41.5
MgO	7.2
MnO	1.0
S	.9

We think the future holds even greater prospects for the development of this mineral both in glass and allied fields.

* * * * * *

Of the many alumina bearing minerals that make up the earth's surface, many hold brilliant prospects for future development. The glass industry being such a high quantity user, it is reasonable to assume that a good number of such developments will be directed toward end use in this industry. Some of the abundant sources of alumina in the Western United States will offer real opportunities as the transportation problem is solved either by relocation of the industry or new methods.

Competition governs the sales market and the value of any mineral is set by the delivered price of its individual elements to the market as opposed to the price of the same elements from other sources plus certain performance factors.

It has been our experience that the successful development of any commodity for the glass industry or, for that matter, any industry requires a rather complete working knowledge of that industry and the end use of the commodity. It is for this reason that engineers make excellent salesmen.

THATCHER GLASS ELECTS W. J. GREEN PRESIDENT

Franklin B. Pollock, chairman of the board of directors of Thatcher Glass Manufacturing Company, Inc., announced that at a meeting of the board of directors on April 4 William J. Green was elected president of the Company. Mr. Green has been executive vice president for the past three years.

Mr. Pollock also announced that Hugh J. McPherson was elected vice president and treasurer. Mr. McPherson was formerly president and general manager of Hydro-Chemical Research and Engineering Company of San Jose, California.

The Board of Directors at this same meeting re-elected the following officers: Franklin B. Pollock, chairman of the board & chief executive officer; and vice presidents David R. Parfitt, administration; P. Stuart Holmquest, container sales; Harry J. Mullany, factories manager, container plants; Roy S. Arrandale, technical director; Robert M. De Garmo, general manager, pressed ware division; Reginald L. Burd, general manager, Pacific coast division; and Gerald J. Graham; Whitney S. Powers, secretary; George H. Winner, assistant secretary; Francis A. Giordon, comptroller; and William E. Stroup, assistant treasurer.

Mr. Charles A. Winding, chairman of the board of the Marine Midland Trust Company of Southern New York, was elected to the executive committee. Re-elected were Mr. Pollock, Chairman, and Messrs. Green, Miltimore, and Yaeger. Mr. W. A. Wood was elected to the advisory committee which administers the portfolio under the company's pension program.

At the annual meeting of stockholders held the same day, the following directors were re-elected: Franklin B. Pollock, Lewis H. Durland, William J. Green, Louis D. Miltmore, David R. Parfitt, Charles A. Winding, Arch K. Wood, W. A. Wood, and Louis Yaeger.

Recent Translations of Russian Papers of Interest to the Glass Industry

Grinding Sheet Glass with Sand

The conclusions arrived at by Brodskii and Zinkova were confirmed by A. S. Totesh, *Steklo i Keramika (Glass and Ceramics)* 11, No. 2, p. 21 (1954).

To make grinding with sand commercially acceptable, the pressure on the grinding wheel must be increased. It was standardized at 120 gram-weight per sq. cm. (i.e. 1.7 psi) and was maintained at this value during the whole course of grinding by placing additional loads on the wheel when the weight of the wheel itself decreased because of wear.

The wheel made 100 revolutions per minute. The glass sheets (of the Fourcault type) were 650x200x6 mm. They were first ground with a sand No. 320 (the particle size is not given) until the whole surface looked frosty; the time required varied according to the roughness of the original sheet from 3 to 25 minutes. In this operation 285 g. sand per minute were employed, and the suspension contained 2 parts of liquid for one part of solid. The resulting surface had indentations of 6-7 microns (i.e. 240-280 microinches).

In the next operation sand M-28 was used. The ratio liquid: solid was 2.5, the expenditure of sand 190 g./min. and the duration 3 min. In this time 15 microns of glass were removed; the indentations on the resulting surface were 5-6 microns deep.

In the third operation, 155 g./min. of M-20 mixed with 2 parts of liquid were employed. After 3 min. of grinding 10 microns were removed and the depth of the disturbed surface was reduced to 4-5 microns.

For the last grinding operation, a wheel made of an organic plastic was used. The sand was M-20, its expenditure was 90 g./min., the suspension contained 4 parts of liquid for one part of solid, 10 microns were removed in 10 minutes, and a surface disturbed for 3-3.5 microns resulted.

Because this depth of broken surface is 1-2 microns smaller than that after grinding with corundum, the following polishing takes 10-15 per cent less time than when corundum is employed. Thus, quartz sand proves to be a suitable (and cheap) substitute for corundum.

Calculation of the Viscosity of Glasses

In *Steklo i Keramika* (*Glass and Ceramics*) 11, No. 1, p. 7 (1954), M. V. Okhotin reproduces eleven nomograms which allow the calculation of the temperature at which the viscosity is 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, 10^9, 10^{10}, 10^{11}, 10^{12} and 10^{13} poises, respectively, for glasses containing 0-5 per cent Al_2O_3, 3 per cent MgO, 3-13 per cent CaO, 10-17 per cent Na_2O and SiO_2 to 100 per cent. The nomograms are based on the equation

$$t = ax + by + cz + d;$$

in it t is temperature in °C, x is the percentage of Na_2O, y-3 is the percentage of CaO, MgO being present in 3 per cent amount, z is the percentage of Al_2O_3, and a, b, c, and d are coefficients which vary with temperature; they are listed in Table I.

TABLE I

Viscosity in poises	a	b	c	d
10^3	−22.87	−16.1	+ 6.5	+1700.4
10^4	−17.49	− 9.95	+ 5.9	+1387.4
10^5	−15.37	− 6.25	+ 5.0	+1194.27
10^6	−12.19	− 2.19	+ 4.58	+ 980.72
10^7	−10.36	− 1.18	+ 4.35	+ 910.96
10^8	− 8.71	+ 0.47	+ 4.24	+ 815.89
10^9	− 2.05	+ 2.3	+ 3.60	+ 656.75
10^{10}	− 8.61	+ 2.64	+ 3.56	+ 715.46
10^{11}	− 7.99	+ 3.34	+ 3.39	+ 669.41
10^{12}	− 7.43	+ 3.2	+ 3.52	+ 637.27
10^{13}	− 6.14	+ 3.15	+ 3.78	+ 598.03

Let, e.g., the glass consist of SiO_2 72, Na_2O 16, Al_2O_3 3, CaO 6, and MgO 3 per cent. The temperature at which the viscosity is 10^7 poises is calculated as follows:

$$t = -10.36 \times 16 - 1.18\,(6 + 3) + 4.35 \times 3 + 910.96 = 747.4°C.$$

If the glass contains more or less than 3 per cent MgO, the temperature found from the above equation has to be corrected as shown in Table II.

TABLE II

Viscosity in poises	Temperature change by substituting 1% MgO for 1% CaO
10^3	9
10^4	6
10^5	5
10^6	3.5
10^7	2.6
10^8	1.4
10^9	0
10^{10}	−1
10^{11}	−2
10^{12}	−3
10^{13}	−4

For instance to find the temperature at which a glass containing SiO_2 73, Na_2O 15, Al_2O_3 2, CaO 9, MgO 1 per cent has a viscosity of 10^8 poises, first the equation

$$t = \frac{-8.71 \times 15 + 0.47 \times 10 + 4.24 \times 2 + 815.89}{\eta}$$

is solved; it gives $t = 698.6°C$. Now the correction from Table II is introduced; it is negative because CaO is substituted for MgO; for 2 per cent additional CaO the correction is $-1.4 \times 2 = -2.8°C$. Hence, the temperature at which the viscosity is 10^8 poises, is $698.6 - 2.8 = 695.8°C$.

Withdrawal of Glass Sheet Without a Debiteuse

I. O. Tomashevich and I. D. Tykachinskii published, in *Steklo i Keramika* (*Glass and Ceramics*) 11, No. 2, p. 17 (1954), miscellaneous observations on the details of manufacturing sheet glass without a debiteuse. The following item has a general interest.

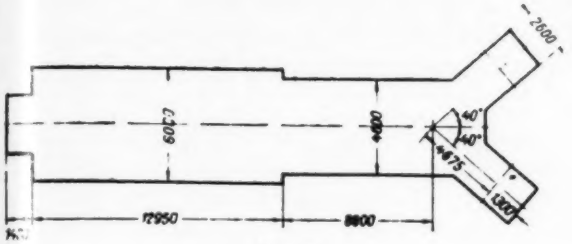


Fig. 1

The glass furnace of the Gorkii plant has the shape schematically shown in Fig. 1. All measures are in millimeters. It is seen that the long melting part (at the left) supplies glass to seven machines (at the right) in each of which a glass sheet is withdrawn. Originally, the channels leading to the machines had no additional external heat insulation. As a result, the average glass temperature near the machines was 1080-1100°C and the glass was considerably colder near the walls than in the middle of each machine chamber. This caused the non-uniformity of sheet thickness illustrated in Fig. 2.

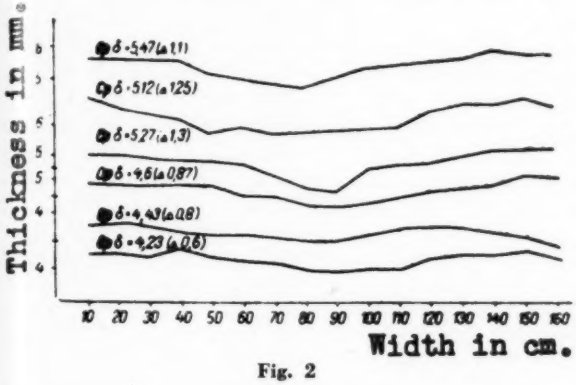


Fig. 2

In this graph the distance from one edge of the sheet (along its width) is plotted along the abscissa and the sheet thickness is represented along the ordinate; to make the graph legible, each line has its own scale at the left. At each line also the average thickness of the sheet (denoted by δ) and the difference between the thinnest and the thickest spot (denoted by Δ) are marked. Thus, e.g., the average thickness of the sheet represented by the uppermost curve was 5.47 millimeters and the difference between different points reached 1.1 mm.; the thinnest spot was 80 cm. from an edge, i.e. in the middle of the sheet which was 160 cm. wide. It is seen that the sheet thickness usually was great near the edges, i.e. where the sheet was fed by the cooler glass, and smaller in the middle where the glass was hotter.

Fig. 3, arranged in the same manner as Fig. 2, illustrates the improvement achieved by heat-insulating the

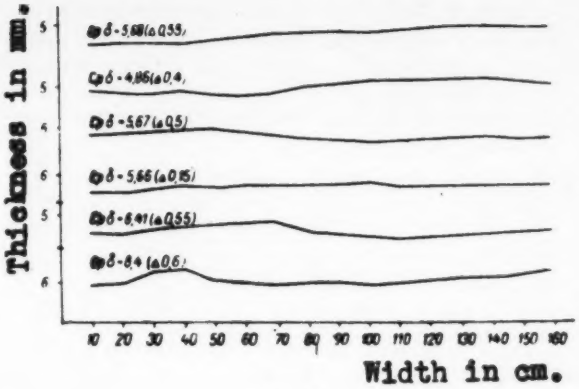


Fig. 3

channels, i.e. reducing the temperature gradient across it. This insulation raised the average temperature of the glass at the machine to 1145°C and, as is seen from Fig. 2, eliminated the difference in thickness between the middle and the edges of the sheet.

Utilization of the Heat of Waste Gases of a Glass Furnace

D. B. Ginzburg and S. S. Chernyakov point out, in *Steklo i Keramika (Glass and Ceramics)* vol. *11*, No. 4, p. 22 (1954), that the removal of waste gases can be accomplished by means of a blower, without a temperature difference, and, consequently, that practically all of the excess heat present in the waste gases can be employed for useful purposes without adversely affecting the working of the furnace.

The waste gases carry up to 30 per cent of the total heat liberated in the furnace. The additional expenses, incurred in installing and maintaining the blower and the machine utilizing the waste heat, are about 30 per cent of the income derived from the use of this waste heat.

The installation tested by Ginzburg and Chernyakov is described and illustrated in the original paper.

Manufacture and Properties of Hardened Glass

In the report published by S. M. Brekhovskikh in *Steklo i Keramika (Glass and Ceramics) 9*, No. 12, p. 14 (1952), on a conference dealing with the production of hardened glass for motor car windows, some data on the manufacture of this glass in Russia and its properties can be found.

The efficiency of a plant was judged by the number of square meters of satisfactory glass (5-6 mm. thick) obtained in one month from one square meter of the heated portion of the electric furnace. This number varied in 1951 from 860 to 2540. The percentage lost because of breakage was 29 per cent in the worst, and 5 per cent in the best managed plant. The market price of hardened glass everywhere was 2.25-2.50 that of window glass of an equal thickness, but the production costs varied from factory to factory within the ratio of 1:2.15. According to the plan, 16 kwh. of energy should be spent on 1 square meter of hardened glass, but the actual expenditure varied from 11.5 to 19.5 kwh.

The properties of the finished product are compared with those of three other glasses in the table. Column *A* is for thick window glass (5-6 mm. thick). Column *B* is for hardened glass (same thickness). Column *C* is for semi-hardened glass, 3 mm. thick. Column *D* is for *laminated glass* ("Triplex").

	A	*B*	*C*	*D*
Impact strength: the sheet is not broken by a ball of 800 g. falling from a height of (cm)	15	120	70	100
Thermal endurance: the sheet endures a temperature difference of (°C)	80	250	150	80
Light transmission for glass having transmission coefficient of 0.85, in percents	88	88	89.7	77
Market price compared to that of thick window glass	1	2.29	?	3.50

Adhesion Between Glass and Metal

In *Steklo i Keramika (Glass and Ceramics)* vol. *11*, No. 4, p. 9 (1954), V. T. Marinina describes two instruments used for determining the adhesion between a glass and a metal.

In one, a horizontal metal plate is suspended under one end of a balance beam and hangs in a furnace. A blob of glass is brought in contact with it from underneath. The furnace temperature is changed until sticking occurs; this is the sticking temperature.

In the other, the load required to break a glass blob off a metal plate is determined at room temperature.

No results are reported.

Viscosity of Some Glasses

B. A. Pospelov reports, in the Russian *Journal of Physical Chemistry 28*, 2180 (1954), some viscosity determinations on many silicate and borosilicate glasses. For the measurements the method of expanding filament was used. A glass fiber was vertically suspended in a furnace. When the temperature equilibrium was achieved, a small load was attached to the bottom end of the fiber. The length of the fiber first increased at once (elastic deformation), then increased more slowly (visco-elastic deformation) and finally, e.g., for 20 minutes linearly increased with time; from this linear increase the viscosity of the glass was calculated by the formula

$$\eta = \frac{mglt}{3\,\pi\,r^2 \cdot \Delta l},$$

in which η is viscosity, m the mass of the load, g acceleration due to gravity, l the length of the fiber, t time, r the radius of the fiber, and Δl the extension of the fiber.

Pospelov proved that the value of η was independent of the mass m and of the diameter of filament when this was varied between 0.5 and 1.8 mm. When the filament was treated with acids, its viscosity seemed to increase but a treatment not resulting in a silica skin did not affect the value of η.

The original paper contains viscosity data for 24 glasses at 5-10 temperatures each. Only data for 11 glasses at three temperatures each are listed here. The glass compositions are shown in Table I, and the viscosities are listed in Table II.

TABLE I.

Glass composition (synthetic) in mole percents

Glass number	SiO_2	Na_2O	third oxide
14	67.99	32.01	—
16	64.51	30.36	5.13 CaO
19	64.51	30.36	5.13 BaO
21	64.49	30.36	5.15 MgO
24	64.51	35.49	—
27	64.51	30.35	5.14 BeO
30	64.49	30.38	5.13 Al_2O_3
33	64.50	30.37	5.13 B_2O_3
12	60.0	20.0	20.0 B_2O_3
15B	60.0	10.0	30.0 B_2O_3
42	60.0	3.0	37.0 B_2O_3

TABLE II

Logarithm of viscosity at different temperatures.

Glass number	Temp., °C	Log. viscosity
14	412°	15.53
	469°	11.69
	566°	7.58
16	420°	15.66
	496°	11.04
	542°	8.80
19	410°	15.13
	477°	10.51
	534°	8.21
21	416°	15.04
	467°	11.14
	535°	8.22
24	428°	14.67
	477°	10.98
	570°	7.68
27	434°	15.51
	501°	10.94
	562°	8.82
30	425°	15.87
	500°	11.38
	556°	9.36
33	435°	15.10
	500°	11.18
	565°	8.57
12	468°	15.0
	540°	11.8
	598°	9.2
15B	475°	14.1
	522°	10.3
	572°	9.4
42	413°	13.6
	470°	10.3
	510°	9.9

Inventions and Inventors

Annealing and Tempering

Glass Bending Methods and Furnaces. Patent No. 2,766,555. Filed November 1, 1951. Issued October 16, 1956. Six sheets of drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company, by Joseph E. Jendrisak.

This invention relates to a method and apparatus for use in bending glass sheets and in particular to a method of bending glass sheets in which different portions of a glass sheet being bent are subjected to different temperatures.

The improved method avoids many of the difficulties of the older glass bending methods by localizing the heat applied to the glass sheets in those portions of the sheet that are to be bent and by maintaining the remainder of each of the glass sheets at a temperature close to but less than the temperature at which the glass softens. This result is accomplished by providing a heating chamber in which the atmosphere is maintained substantially quiescent and in which most if not all of the heat is supplied near the top of the heating chamber so that a substantial heat gradient exists between the bottom and the top of the heating chamber. The molds which carry the glass sheets through the furnace are arranged so that those portions of a glass sheet to be bent extend into the hotter portion of the chamber.

The improved method is especially useful in the production of curved window glass such as is used in automobiles and more particularly to curved window glass in which the curvature is confined to a relatively small portion of the window area.

There were 14 claims and the following references cited in this patent: 682,570, Sage, Sept. 10, 1901; 1,635,861, Peiler, July 12, 1927; 2,057,763, Boyles et al., Oct. 20, 1936; 2,131,873, Goodwillie, Oct. 4, 1938; 2,167,318, Verlay, July 25, 1939; 2,215,228; Oliver, Sept. 17, 1940; 2,348,278, Boyles et al., May 9, 1944; and 2,608,030, Jendrisak, Aug. 26, 1952.

Feeding and Forming

Burning-off Hollow Glassware. Fig. 1. Patent No. 2,729,031. Filed January 5, 1951. Issued Jan. 3, 1956. One drawing sheet. Assigned Union Carbide & Corbon Corp. by R. A. Wolf.

The invention relates to apparatus for severing the waste material or moil from glass tumblers or other hollow glassware.

The work piece is projected into the burner (see Fig. 1), and both a flame and a blast of cooling fluid are applied to it, the flame being supplied by the oxygen-fuel mixture issuing radially inward from the burner tips 34 and the cooling fluid issuing inwardly from the slit 35. As the glass is softened and its viscosity decreased by the flame, the softened glass flows under the force exerted by the weight of the moil. At the same time the blast of cooling fluid, by cooling the softened glass,

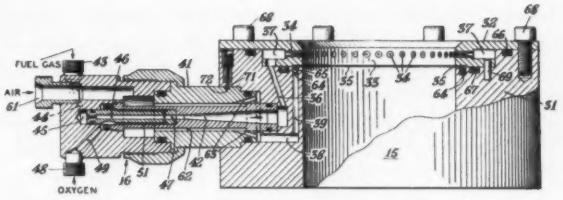


Fig. 1

serves to increase its viscosity and accordingly its resistance to flow, in a circumferentially extending area which is below and immediately adjacent the flame.

The application of the cooling fluid simultaneously with the flame confines the stretching or drawing of the glass, with concurrent attenuation of the wall, to a narrow circumferentially extending area lying between the flame and the cooling fluid. As a consequence the effects of variations in wall thickness are minimized and the defects which have heretofore resulted from permitting the stretching or drawing of the glass wall to be distributed over a more extended area are virtually eliminated. In the case of small glassware, such as tumblers, for instance, it has been possible to decrease the number of rejects for defective cut-off to less than one per cent.

There are two claims and the following references were cited in this patent: 472,198, Nelson, Apr. 5, 1892; 2,215,980, Schreiber, Sept. 24, 1940; 2,295,522, Shorter, Sept. 8, 1942; 272,308, Great Britain, June 15, 1927; and 288,197, Germany, Oct. 23, 1915.

Corrugated Sheet Glass. Fig. 2. Patent No. 2,724,214. Filed November 27, 1951. Issued November 22, 1955. Three sheets of drawings. Roger Guilleminot.

An improved method of producing corrugated sheet glass is given.

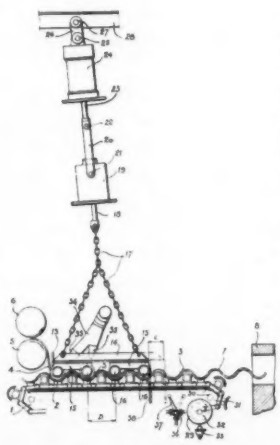


Fig. 2

As seen in Fig. 2 the moving member 14-16 is lowered down on the glass sheet 4, fed from the rolls 5-6 as soon as a concave portion 2 has been supplied with glass. Under the weight of the structure 14-15-16, the rollers apply the glass into the bottom of the valleys in the corrugated chain. The chain carries this structure with it over a distance C less than the pitch length D of the corrugations. When this distance has been covered, the cams 29 operate the valve 33, which acts to let compressed air into the cylinder 19, through the flexible pipe 40 (not shown) which results in lifting rod 18 with

chains 17, and the whole structure 14-15-16. Due to the arrangement of shaft 27, which is systematically displaced with respect to the centre of gravity of the frame, the frame 14 thus lifted tends to swing back under its own weight toward the stop 13. When a further concave portion 2 has moved into the place vacated by the preceding one and has been supplied with semi-fluid glass, i.e., after the chain had advanced by a pitch length D, the cams 29 actuate the valve 33 to exhaust the compressed air from cylinder 19, through flexible pipe 41 (not shown). The assembly including frame 14 and rollers 16 is then lowered down onto the chain to accomplish a fresh cycle.

The distance C covered by the rollers in engagement with the chain can be adjusted by acting on the shape of the cams 29. It is seen that with the arrangement used, the semi-fluid glass sheet is pressed into the bottom of the concave parts 2 of the chain as many times as there are rollers 16 provided. The weight of frame 14, which supports 15 and rollers 16 is so adjusted that a sufficient degree of compression will be obtained to cause a total contact of the glass with the corrugated chain surface throughout the successive depressions thereof.

There were four claims and the following references cited in this patent: 1,450,222, Pattison, Apr. 3, 1923; 2,350,996, Atkinson et al., June 13, 1944; 2,586,481, Rooksby et al., Feb. 19, 1952; 2,590,768, Guilleminot et al., Mar. 25, 1952 and 622,094, Great Britain, Apr. '27, 1949.

Cathode-Ray Tube Sealing Apparatus. Fig. 3. Patent No. 2,731,771. Filed November 15, 1949. Issued January 24, 1956. Two sheets of drawings. Assigned to Rauland Corp. by A. J. Harder, Jr.

This invention relates to improved apparatus for the fabrication of cathode-ray tubes.

The operation of the apparatus of Fig. 3 is as follows: The vitreous neck 11 is placed on the neck chuck 50 and the rods 52 are rotated so that the neck is firmly held in place and the air seal 57 is bulged against the inside surface thereof to effect an air seal. The metal cone 10 is placed in the annular bracket 61 and tapped into place so that its axis is in a vertical position, the cone being firmly held in this position by the permanent magnets (62). The glass window 12 is now placed on the flange 13.

When the glass rim of the section 11a reaches a plastic state due to heat radiation from the heated lower portion of the cone, air is introduced into the air cylinder 42 causing the lift arm 38 to move against the action of the hydro-check 44, in turn causing the lift tube 31 to rise slowly, thereby moving the flared portion 11a of neck 11 into contact with the cone 10. The downward travel of plunger 41 of the air cylinder 42 and, thus, the upward travel of the neck 11, is arrested by the screw 46 which is adjusted to establish a desired amount of contact between the flared portion 11a and the lower rim of the cone 10.

The burners 14 are turned off before the rim of section 11a becomes excessively molten and "runs", so that a satisfactory seal is produced between the neck and the cone. Air is now introduced into the air cylinder 76 to raise the burner ring 67 into its uppermost position shown

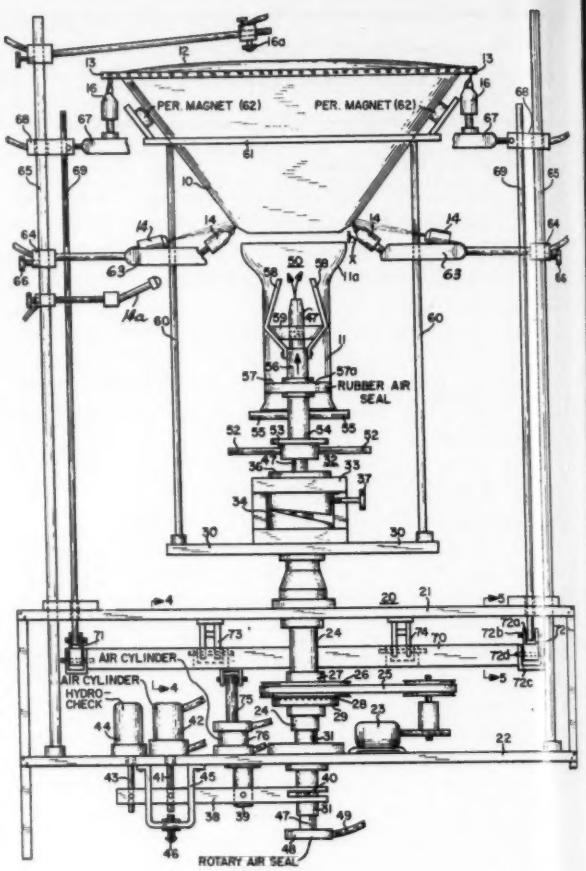


Fig. 3

in the drawing, and the burners 16 are ignited for locally heating the flange 13. The motor 23 continues to rotate the cone 10 to provide uniform heating of the flange 13. Air is introduced through the rubber tube 49 and rotary air seal 48 into the air tube 47 and, hence, into the interior of the cone to prevent the edge of window 12 from sagging during the window sealing operation. It is usually the practice to provide a small aperture 57a in the air seal 57 to allow some of this air to escape and avoid excessive pressure in the interior of the cone.

After the edge of the window 12 has reached a plastic state, the burners 16 are turned off and the edge settles into the flange 13, sealing the window to the cone 10. The air in cylinder 76 is now released and the burner ring 67 drops to its lowermost position, enabling an operator to place tongs around the conical portion 32 to remove the assembled envelope.

There were 5 claims and the following references cited in this patent: 829,538, McDonnell, Aug. 28, 1906; 1,461,155, Madden et al., July 10, 1923; 1,869,533, Wetmore, Aug. 2, 1932; and 2,477,332, Garbe, July 26, 1949.

Centrifugal Molds and Method. Patent No. 2,771,712. Filed July 15, 1953. Issued November 27, 1956. Three sheets of drawings; none reproduced. Assigned to Owens-Illinois Glass Company by Clifford J. Reynolds.

The invention is adapted for molding bowls or hollow

bodies such as used for television picture tube bodies. In molding such a bowl the charge or gob of molten glass is placed in the mold and the latter rotated rapidly, thereby causing the glass to be spread and moved upwardly along the sides of the mold and over a peripheral ledge near the upper edge of the mold. The glass spreads outward over the ledge in a horizontal direction and then upward to form the rim of the bowl.

The invention provides grooves or recesses in the ledge of the mold which aid in obtaining the proper flow of the glass up over the top edge of the mold. Other recesses are designed and operate primarily to prevent rotational slippage of the glass and to retain the glass against the mold walls, particularly during the period of deceleration after the glass distribution has been substantially completed. The invention also provides additional grooves to lock the glass to the mold and prevent it from folding and/or wrinkling during such operation.

There were 9 claims and the following references cited in this patent. 2,350,052, Luertzing, May 30, 1944; 2,-577,423, Ludwig et al., Dec. 4, 1951; 2,629,206, Giffen et al., Feb. 24, 1953; and 2,662,347, Giffen, Dec. 15, 1953.

Apparatus For Conditioning Glass To Be Drawn Into Sheets. Patent No. 2,771,711. Filed August 1, 1955. Issued Nov. 27, 1956. Three sheets of drawings; none reproduced. Assigned to Compagnies Reunies des Glaces & Verres Speciaux du Nord de la France by Bernard Long. The invention relates to apparatus for the manufacture of glass sheets by a continuous drawing process.

The improved apparatus consists essentially in means for cooling a stream of cleared glass in an abrupt but controlled manner, while running it rapidly down through a short inclined canal which connects the fining zone of the tank furnace with a drawing chamber. The cooling is carried out by means of successive radiation and convection coolers which permit the regulation not only of the temperature of the surface and lower levels, with the volume of flow of the stream being maintained constantly equal to the volume of glass under pressure which is continuously drawn up into the sheet from the drawing bath. The quantity of cleared glass entering the drawing chamber is always equal to the quantity of glass being drawn up from that chamber in sheet form. This prevents any excess of glass from flowing back from the drawing chamber into the melting tank after having already been partially cooled.

The glass sheet is drawn from the open surface of the drawing bath at the same time that the incoming cleared glass is fed in under pressure. This increases the production, reduces the drawing force which must be applied to the skin of the sheet and consequently increases the smoothness of its surfaces.

There were 13 claims and the following references cited in this patent. 1,489,823, Crowley, Apr. 8, 1924; 1.554,851, Hitchcock, Sept. 22, 1925; and 1,863,156, Frink, June 14, 1932.

Furnaces

Regenerative Furnaces. Fig. 4. Patent No. 2,723,842. Filed March 15, 1951. Issued November 15, 1955. Two sheets of drawings. Assigned to the Morgan Construction Company by Henry S. Hall.

This invention relates to furnace control apparatus, and more particularly to apparatus for controlling the flow of hot gases from furnaces of the regenerative type.

With the various dampers adjusted as shown in Fig. 4, the combustion air supplied by the fan 27 will be discharged through the nozzle 16', then flow downwardly through the regenerator 11' to absorb heat therefrom, and thence enter the furnace 10. The ejection air supplied by the fan 23 will be discharged through the nozzle 16 and create a suction which will draw hot gases upwardly through the regenerator 11, thereby heating the said regenerator. The mixture of hot gases and air will travel upwardly through the tube 14, thence through the cross-over pipe 35 and the duct 36 to the precipitator 33, which will remove the fine particles of solid material

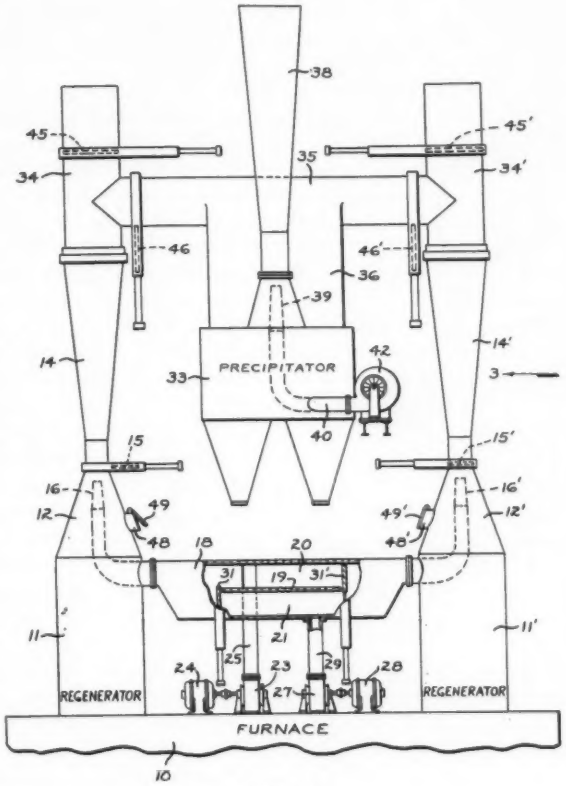


Fig. 4

from the gases. The cleaned gases will then travel upwardly through the Venturi tube 38 to atmosphere, under the influence of the air current supplied by the fan 42 and discharged upwardly through the nozzle 39. The damper 49 will be held open sufficiently to admit cool air to the chamber 12 as required to prevent an excessive temperature in the gases entering the precipitator 33. To reverse the gas flow through the furnace after a suitable interval of time, the dampers 15 and 49 will be closed, the dampers 15' and 49' will be opened, the damper 31 will be raised, and the damper 31' will be lowered. Thereupon the combustion air from the fan 27 will flow downward through the regenerator 11 to the furnace, while

the ejector air from the fan 23 will withdraw hot gases upward through the regenerator 11′ and deliver them, mixed with cool air, to the precipitator 33. The fan 27 will be suitably controlled to provide the correct flow of air for combustion of fuel in the furnace. The fans 23 and 42 will be suitably controlled to maintain the desired pressure conditions in the furnace 10 and the precipitator 33 respectively.

There was one claim and the following references were cited in this patent: 1,012,488, Wedge, Dec. 19, 1911; 1,040,460, Taylor, Oct. 8, 1912; 1,310,455, Tainton, July 22, 1919; 1,811,459, Dyrssen, June 23, 1931; 1,835,210, Dyrssen, Dec. 8, 1931; 1,848,185, Mawha, Mar. 8, 1932; 1,900,397, Isley, Mar. 7, 1933; 2,042,475, Meharg et al., June 2, 1936; and 2,477,420, Rhoades, July 26, 1949.

Electric Melting of Glass. Fig. 5. Patent No. 2,749,379. Filed June 3, 1953. Issued June 5, 1956. One page drawings. Assigned to Jenaer Glaswerk Schott & Gen. by Walter Geffcken and Carsten Eden.

In the electrical melting of glass by joulean heat, the heater current is usually brought to the melting charge by means of electrodes which dip into the melting charge or in another way secure a good transient. Due to the electrolytic decomposition of the melt, which frequently occurs in such cases, and which mostly causes a coloration of the glass, it is in general, in spite of the use of A. C., not possible to melt a pure and uncolored glass if a heater current of the usual power supply frequency of 50 cycles per second is being used. For this reason, it was suggested to increase the frequency of the heater current.

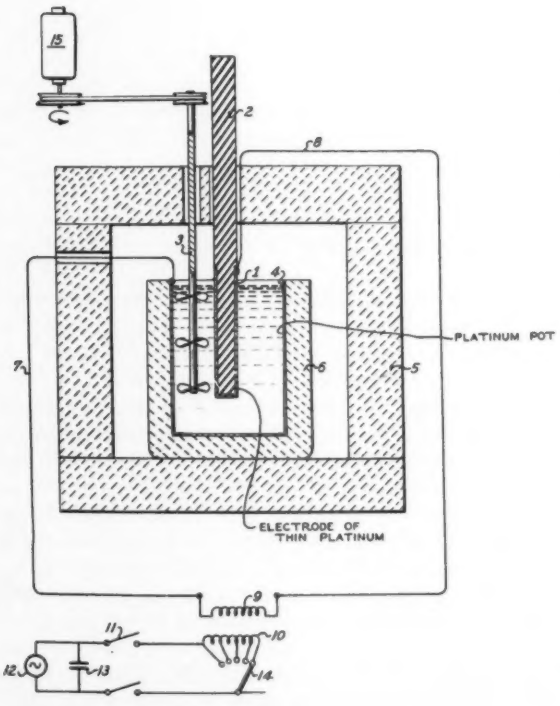


Fig. 5

The glass melt is maintained within the platinum casing 4, of the pot 6, as shown in Fig. 5, and is melted by the heat of the electric current passing between the electrodes. The alternating current of the source 12 which passes through the melting charge, as mentioned, has a frequency of above 2,000 cycles per second. In this way melts will result which are faultless for technical purposes, though in place of the platinum metal as the electrodes conventional graphite electrodes may be used. For even higher demands, it is advisable to use metal electrodes instead of the conventional graphite electrodes, since the former exhibit less burning off. In order to sufficiently suppress colloidal atomization of the electrodes, in spite of the increased current density, it is advisable to increase the frequency of the heater current to at least 4,000 cycles per second.

It may be possible that under certain conditions the increased transient density will necessitate special attention so that the temperature at the electrodes does not rise beyond the permissible margin. A simple way of doing this would be to bring about a relative motion between the electrodes and the melting charge, e. g. by bringing the electrodes opposite the stagnant melting charge into motion so that they continuously contact other parts of the melting charge. Another way would be to let the melting charge pass continuously by the electrodes, by means of a stirring apparatus 3, driven by a conventional electric motor 15, set up near the electrodes.

There were 12 claims and 10 references cited in this patent.

Tube and Cane Machines

Sealing-Off Lamp Envelopes. Patent No. 2,740,570. Filed Sept. 28, 1953. Issued April 3, 1956. Two pages drawings; none reproduced. Assigned to General Electric Co., by R. L. Breadner and C. H. Simms.

This invention relates to method and apparatus for the manufacture of low pressure mercury vapor fluorescent electric discharge lamps. The envelope of the device is provided with an exhaust aperture in the wall thereof; the envelope wall is brought into abutment with the wall of an exhaust chamber, connected to an exhaust pump, so that the exhaust aperture registers with an aperture in the wall of the exhaust chamber. A gas-tight gasket is provided between the abutting wall surfaces of the envelope and exhaust chamber around the apertures therein. The device is then heated for degassing while being exhausted through the exhaust aperture. After the introduction of the envelope filling, if any, a sealing plug or washer is applied to the exhaust aperture in the envelope wall so as to provide a hermetic closure thereof.

The sealing plug or washer for closing the exhaust aperture may be of a material, such as a non-porous rubber, sufficiently deformable, or so coated with a wax or grease, as to seal firmly and hermetically in or over the exhaust aperture under the external pressure resulting from the differential between the external atmospheric pressure and the sub-atmospheric filling pressure within the envelope and exhaust tube. Alternatively, the sealing plug or washer may be positively sealed to the envelope by the use of an adhesive.

There were 5 claims and the following references cited:

(*Continued on page* 278)

Research Digest

The Analysis of Gas Content of Bubbles In Glass Smaller than 0.2 mm. Diameter

The existing methods of analysis deal with bubbles in glass not smaller than 0.3, or even 0.5 mm., while the majority of bubbles occurring in glass are less than 0.2 mm. in diameter. Seedy glass containing very small bubbles is, at times, commercially unacceptable. Slaviansky and Krestinikova in the February 1956 News and Reviews section of the *Journal of the Society of Glass Technology* (Translation from the original, *Steklo i Keramika*, 10, 11-15 (1953) by S. Kruszewski) report on a search for an analytical method suitable for bubbles as small as 0.06-0.07 mm. diameter.

Any method must include the following stages:

(a) the preparation of a glass sample containing a bubble;

(b) the extraction of the gas content;

(c) the gas analysis.

In the method proposed all the manipulations are carried out under a microscope. A specimen must be prepared in such a way that the bubble is surrounded by only a small quantity of glass. This is achieved by grinding and polishing a flat specimen containing a bubble, down to a thickness of approximately 1 mm. The glass around the bubble is then broken away, leaving an area of not more than 2-4 mm.^{2}; such a specimen will be completely in the field of vision of a microscope at x 80-100 magnification. The preparation of the specimen is rather tedious and requires some practical experience of optical glass grinding and polishing machines.

If it is necessary to analyze the gas contents of bubbles in a glass sample taken directly from a furnace the procedure is much simpler. A gather of glass is blown into the shape of a round flask of about 1 mm. wall thickness, or is drawn into threads about 1 mm. in diameter. Pieces of glass containing bubbles, which are broken away from the flask or the thread, are suitable for analysis without any further preparation.

A special apparatus, has been designed for the extraction of gas from the bubbles. It consists of two metal plates, the distance between which can be adjusted by means of screws.

A plano-convex lens is mounted in an opening in the top plate, on a common optical axis with a plano-concave lens fixed on to the bottom plate. The radii of both lenses are identical (10 mm.) and their curvatures fit precisely into each other. The apparatus is placed on a microscope stage, the thickness of the top lens being such as to allow any point on its convex surface to be brought into focus.

The glass sample containing a bubble is placed on the bottom lens and immersed completely in 2-3 drops of freshly distilled glycerine. Care must be taken to avoid the inclusion of any air bubbles in the glycerine. The top lens is gradually brought down on to the specimen, the latter being kept under continuous observation through the microscope. The specimen is compressed until a crack running through the bubble appears; glycerine then enters the bubble and reduces the volume occupied by the gas. The gas is liberated from the cracked bubble by careful hand manipulation of the bottom lens.

It was assumed initially that bubbles situated close to each other in one piece of glass would be of a common origin, and consequently contain gases of similar composition and pressure. If this were so, the analytical procedure would be to open a number of specimens, each of them under glycerine containing a different absorbent; e.g. an alkaline solution of glycerine to absorb CO_2, an alkaline solution of pyrogallol in glycerine to absorb O_2, etc. Based on the original assumption, the composition of the gas would be determined by measuring the relative decrease in the gas bubble diameter in each absorbent. The original bubble diameters (d_o) in microns are plotted against the ratios of the gas bubble diameter after absorption to the original diameter $\left(\frac{di}{do} \times 100\right)$. If the original assumption of similar compositions of neighboring bubbles is correct, the points on the graph corresponding to a given absorbent would be distributed within a certain band of $\frac{di}{do}$. No such distribution could be observed however, and it was concluded, therefore, that the gas contents of the bubbles were dissimilar and that a complete analytical method for each individual bubble was necessary.

It was noticed that when bubbles containing CO_2 were opened under glycerine, the gas bubble diameter continued to decrease for some time after the introduction of glycerine, so further tests were carried out to find a confining liquid which gives the least absorption of CO_2.

From these various tests a solution of sodium chloride in water, acidified with sulphuric acid, appeared to be better than the other liquids, but although in this solution the absorption ceases in 10-15 minutes, the initial absorption is fairly rapid and is independent of the original concentration of CO_2; in addition, this solution is corrosive to the metal parts of the apparatus.

In view of these disadvantages of the $NaCl+H_2SO_4$ solution, it was decided to use freshly distilled glycerine in which the absorption of gas bubbles containing CO_2 is not rapid and depends on the original CO_2 concentration. Redistillation of the glycerine is essential to get rid of water, since glycerine is hygroscopic and the presence of water facilitates CO_2 absorption.

Further experiments on the absorption of CO_2 by freshly distilled glycerine led to the preparation of graphs of absorption velocity as a function of the original CO_2 concentration in the bubbles. The graphs were used in the bubble analysis to correct for CO_2 absorption from

(*Continued on page* 286)

(*Continued from page* 276)

239,058, Powell, Mar. 22, 1881, and 1,430,118, Rossignol, Sept. 26, 1922.

Glass Sealing Alloy. Fig. 6. Patent No. 2,730,443. Filed November 10, 1951. Issued January 10, 1956. One sheet of drawings. Assigned to The Carpenter Steel Company by C. B. Post and W. S. Eberly.

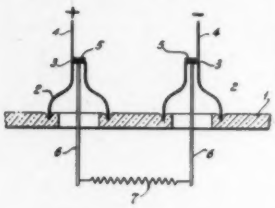


Fig. 6

This invention relates to iron-nickel-titanium alloys and is an improvement in respect of the invention Patent 2,471,079, issued May 24, 1949.

The filament 7, shown in Fig. 6, is carried by pins 6, supported by corresponding ferrules 2, having cap portions 3, and the ferrules 2 being sealed into the glass 1 as indicated. Electrical connections is obtained by lugs 4, having base portions 5 bonded to the ferrules by means of a low temperature melting solder, e.g. alloy of lead and tin.

In accordance with the invention of U. S. Patent 2,471,079 the ferrules are made of the iron-nickel-columbium alloy. However, it has been found by production experience that the bond between the solder and the surface of the ferrule for joining the lugs to the ferrules presented difficulty due to the weakness of the bond. The weakness of the bond is due to surface characteristics that lead to poor wetting by the solder.

By employing titanium as described, all the advantages of the columbium alloy are retained and the above mentioned disadvantage is obviated and an improved "non-gassing" alloy thereby obtained. The improvement resides particularly in imparting a new and unexpected property, that is, the wetability of the alloys by low melting (lead-tin) solders commonly used to join other metallic parts of the ferrules.

Generically the invention is defined by the following range of composition:

Carbon	nil to 0.7
Manganese	.50 to 2.00
Silicon	.25 to 1.00
Nickel	.30 to 60
Titanium	0.30 to 0.70

There is 1 claim and the following references are cited in this patent: 1,480,706, Yensen, Jan. 15, 1924; 2,048,163, Pilling et al., July 21, 1936; 2,471,079, Post, May 24, 1949; 2,513,241, Holst, June 27, 1950, and 556,372, Germany, Aug. 6, 1932.

Miscellaneous Processes

Glass Refractory Composition. Patent No. 2,748,007. Filed September 12, 1951. Issued May 29, 1956. One page of drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by Alfred E. Badger and Donald E. Sharp.

The present invention relates broadly to glass contacting refractories and more particularly to an improved refractory composition for use in the construction and/or operation of glass furnaces.

In conventional furnace construction the glass contact portions of the side walls and the bottom are manufactured from a suitable refractory material such as clay, zircon or fused mullite. When the molten glass comes in contact with the refractories forming the bottom and glass contact side walls of the furnace, some of the refractory material dissolves in the glass to form a "refractory glass" which differs in chemical composition from the main body of glass. This refractory glass has a higher surface tension than that of the main glass and produces objectionable cords in the glass. Due to the tendency of these cords to "ball up", they present a small surface to the glass and thereby cause the diffusion process between the cords and glass matrix to occur more slowly. Consequent upon this disadvantageous lack of homogenization between the cords and molten glass body is a product possessive of objectionable optical effects and decreased mechanical strength.

However, such difficulties are herein substantially eliminated by the provision of a glass contact refractory containing a relatively small amount of vanadium or chromium oxide, these compounds have the effect of decreasing the surface tension of the refractory glass which causes cords, causing the cords to spread out and present a larger contact area, and resulting in an acceleration of the homogenization process.

Vanadium oxide (V_2O_5) or chromium oxide (Cr_2O_3) are preferably added to the refractory in the process of manufacture and experience has indicated that more than 1 per cent and less than 5 per cent of these compounds in proportion to the total quantity of clay or other refractory material is productive of the most satisfactory results in flat glass manufacture. Although tests have indicated that the addition of specified amounts of either one of these compounds has produced the desired decreases in surface tension of the refractory glass, it may be desirable under certain circumstances to add both of the oxides to the refractory. However, even in such a case, the total percentage of both V_2O_5 and Cr_2O_3 in the refractory should not exceed 5 per cent.

There were 7 claims and the following references were cited in this patent: 2,207,558, Singer, July 9, 1940; 2,261,400, Morgan, Nov. 4, 1941; 2,311,228, Heany, Feb. 16, 1943; 2,332,014, Schwartzwalder, Oct. 19, 1943; 2,369,709, Baumann, Feb. 20, 1945; 2,482,580, Feichter, Sept. 20, 1949 and 377,964, France, 1907.

Thermal Evaporation. Patent No. 2,748,026. Filed March 26, 1953. Issued May 29, 1956. Three pages drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by James C. Ogle, Jr.

This invention relates broadly to the application of multiple coatings of thermally evaporable material onto a support body. More particularly, it relates to an improved method and apparatus for successively depositing multiple coatings by thermal evaporation in a vacuum chamber without the necessity of breaking the original vacuum created therein.

According to this process, the source of material which is to form the coating is supported on a heating element

(*Continued on page* 285)

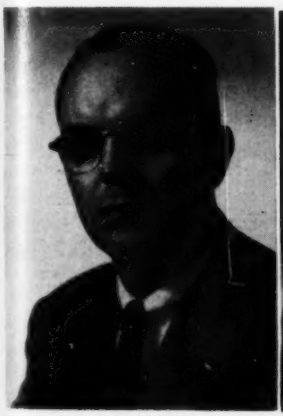
CORNING GLASS WORKS MAKES CHANGE IN MANAGEMENT

A change in the executive management of Corning Glass Works and election of three new vice presidents was voted by the company's board of directors.

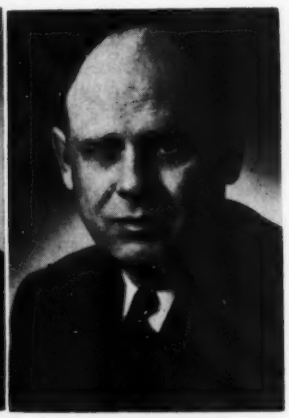
A. Houghton Jr.

Amory Houghton was re-elected chairman of the board of directors and granted a leave of absence during the period of his service as United States Ambassador to France. William C. Decker was re-elected president and was named chief executive officer of the company.

Newly elected vice presidents were: Paul T. Clark, general manager of the company's Technical Products Division and a member of the firm since 1934; Amory Houghton Jr., great-great-grandson of the founder of the company, who will assume responsibility for staff divisions; Arthur W. Weber, director of the Engineering and Manufacturing Staff Division and a member of the firm since 1935.



P. T. Clark



A. M. Weber

The elections were announced after the director's organization meeting which followed the annual meeting of stockholders held at the Corning Glass Center.

Other officers were were re-elected were George D. Macbeth, vice president and controller; Charles D. LaFollette, vice president and treasurer; John L. Hanigan, John Carter, Thomas Waaland, Dr. William H. Armistead, Dr. John F. G. Hicks and R. Lee Waterman, vice president; Frederick H. Knight, secretary; Henry H. Sayles and William W. Sinclaire, assistant secretary, and C. Henry Kruidenier and Rogert W. Foster, assistant treasurer.

HIGH MODULUS FIBROUS GLASSES DEVELOPED

A 50 per cent increase in modulus of elasticity of fibrous glass was achieved in recent research for the Air Force by the continuous formation of fibers of a calcium aluminate glass in a small textile glass bushing. High modulus fibrous glasses are required by the Air Force primarily for reinforced plastic materials.

The complete report of this research has just been released by the Air Force for dissemination to industry through the Office of Technical Services, U. S. Department of Commerce.

Resistance of these glasses to chemical attack by water and water vapor is much less than that of commercially produced textile fibrous glass. The glasses are resistant to hydroflouric acid but are completely soluble in hydrochloric acid. Their dielectric constants are higher than that of present textile glass, and the loss tangents are approximately the same. An exploratory study of glass-plastic combinations from the calcium aluminate glass was also initiated in the research. Volan A was found to be the best coupling agent tested for this glass.

This report, PB 111789 *The Development of Fibrous Glasses Having High Elastic Moduli*, G. R. Machlan, Owens-Corning Fiberglas Corp., for Wright Air Development Center, Nov. 1955, may be ordered from OTS, U. S. Department of Commerce, Washington 25. It contains 112 pages, price $3.

EXOLON PRESENTS GRADER AND SEPARATOR TO ALFRED U.

The Exolon Company of Tonawanda recently presented two of its products to Alfred University, a multiform grader and a magetnic separator, which will be used by faculty and students at State University of New York College of Ceramics at Alfred.

Representing Exolon president L. E. Thayer at the presentation ceremony was Harvey J. Robillard, sales engineering manager. Receiving the equipment on behalf of Alfred University were President M. Ellis Drake and John F. McMahon, Dean of the College of Ceramics at AU.

The multiform grader and magnetic separator will be used in the laboratories of the College of Ceramics, according to Dean McMahon. The Exolon Company, which manufactures these machines, also produces fused aluminum oxide and silicon carbide for abrasive and refractory uses.

DR. SILVERMAN TO PRESIDE AT CHEMICAL NOMENCLATURE COMMISSION

The Commission on Inorganic Chemical Nomenclature of the International Union of Pure and Applied Chemistry will have Dr. Alexander Silverman, Professor of Chemistry, Emeritus, University of Pittsburgh as presiding officer. The Commission will meet in Paris, July tenth to 26th, and hopes to publish a revision of the 1940 rules this year. Professor Silverman has been invited to speak on "Some Eminent Chemists of the Twentieth Century" at the Centennial Celebration of the Chemical Society of France. Dr. Silverman will also speak before the High Temperature Division of the Inorganic Chemistry Section of the International Congress of Pure and Applied Chemistry on "The Production of High Melting Glass Fibers".

A HIGHLY ALKALINE pH STANDARD

To increase the accuracy of pH measurements in the highly alkaline range, the National Bureau of Standards is recommending a sixth pH standard[1] for use along with the five pH standards previously established. Consisting of a saturated solution of calcium hydroxide, the new standard will provide an additional fixed point in the standard pH scale which the Bureau maintains.

This scale was set up[2] in 1948 to meet the need for a single standard pH scale as a basis for accurate measurement of acidity and basicity in aqueous solutions. In the manufacture of many commerical products—for example, paper, textiles, dyes and ceramics—the rapidity and efficiency of the processes depend upon the accuracy with which pH can be determined.

The NBS standard pH scale is defined in terms of several fixed points in much the same manner as is the International Temperature Scale. The primary standards of the pH scale are solutions whose pH values are only slightly affected by dilution or by accidental contamination with traces of acid or alkali from the walls of the container or from the atmosphere. The substances from which the standard solutions are prepared are, in turn, stable materials which may be obtained as certified standard samples from the Bureau. The five standards thus far established cover the pH range from 1.68 to 9.18 at 25°C. However, the need for a highly alkaline standard has been felt for several years.

The new pH standard is a solution of calcium hydroxide saturated at 25°C. This reference solution is very easily prepared. No weighings are necessary, as a solution of reproducible composition can be made merely by shaking finely granular calcium hydroxide with water. The calcium hydroxide is prepared by igniting calcium carbonate conforming to American Chemical Society specifications for the reagent grade low in alkalies. The solid material must not be contaminated with soluble alkalies, but the presence of carbonate is of no concern, since calcium carbonate will precipitate from the solution at the time of preparation. The filtered solution of calcium hydroxide supersaturates readily and can normally be used over a wide range of temperates without separation of the solid phase.

The pH of this solution is 12.45 at 25°C. and is a rather sensitive function of temperature. Values of pH on the NBS conventional activity pH scale have been assigned at intervals of 5 degrees from 0° to 60°C. Although standard samples of calcium hydroxide are not yet available from the Bureau, highly pure preparations can be readily made from commercially available grades of calcium carbonate.

(1) For further details, see Calcium hydroxide as a highly alkaline pH standard, by R. G. Bates, V. E. Bower, and E. R. Smith, J. Research NBS 56, 305 (1956) RP 2680.
(2) Standardization of the pH scale, NBS Technical News Bulletin 31, 138 (1947).

TROPICAL GLASS & BOX DISSOLVED

Wm. V. Fisher, President of Anchor Hocking Glass Corporation, Lancaster, Ohio has just announced that the corporate entity known as Tropical Glass & Box Company, a wholly owned subsidiary of Anchor Hocking Glass Corporation, has been dissolved and all assets and liabilities acquired by the parent company.

Mr. Fisher stated that all operations of the former company will be conducted hereafter as a part of Anchor Hocking Glass Corporation. The dissolution of the subsidiary will facilitate the integration of its operations with those of Anchor Hocking.

Since the acquisition of the Tropical Glass property, by Anchor Hocking, in August, 1954, major plant and warehouse modernization, additions and improvements have been effected. At the present time Anchor Hocking is doubling the size and productive capacity of the plant, at the same time continuing to give uninterrupted service to its customers. This factory produces glass bottles and jars for the packaging of food products, juices, syrups, beverages, wines and liquors. It serves the glass package needs of customers in the South East and South Central sections of the country.

GLASS INDUSTRY PROVIDES BACKGROUND FOR NEW COMIC STRIP

King Features Syndicate, New York, has launched a new comic strip, "Judd Saxon", which deals with the adventures of a young man who starts his career in the glass manufacturing industry. The writer, Jerry Brondfield and the artist, Ken Bald, have both taken pains to make sure the dialogue and backgrounds are authentic. Brondfield spent the better part of a week at a glass container factory in Jersey City, N.J. learning the history of glassmaking, present day methods of manufacture, ingredients, procedures, marketing, packaging, and other data on the industry. Bald spent several days at the plant with a camera, taking hundreds of pictures which will serve as reference points in the drawing of the comic strip.

THIS IS OUR MIXER WHERE WE TOSS SAND, LIME AND CHEMICALS TOGETHER. A CONVEYOR BELT MOVES THE MIX TO THE FURNACE.
MECHANIZED ALL THE WAY, EH?
WELL, WE'RE SURE BETTER OFF THAN THE EARLY EGYPTIANS WHO INVENTED THIS STUFF 5000 YEARS AGO, GIVE OR TAKE A CENTURY.
KEN BALD 5-6
YOU'D BE SURPRISED HOW MUCH ROMANCE THERE IS IN GLASS, MISS CALDWELL. HERE'S WHERE THE DRY MIX POURS INTO THE FURNACE.
ROMANCE? WELL, PERHAPS, BUT I'D SAY IT'S A POOR SUBSTITUTE FOR THE REAL THING...!
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Current Statistical Position of Glass

Employment and Payrolls: Employment in the glass industry during February, 1957 was as follows: *Flat Glass:* A preliminary figure of 29,900 for February, 1957 indicates a decrease of 3.2 per cent from the adjusted 30,900 reported for January, 1957. *Glass and Glassware, Pressed and Blown:* A decrease of .7 per cent is shown by the preliminary figure of 80,400 for February, 1957, when compared with the adjusted figure of 81,000 for January, 1957. *Glass Products Made of Purchased Glass:* The preliminary figure of 15,400 for February, 1957 indicates a decrease of 1.3 per cent from the previous month's adjusted figure of 15,600.

Payrolls in the glass industry during February, 1957 were as follows: *Flat Glass:* A decrease of 6 per cent is shown in the preliminary $14,832,924.58 when compared with January, 1957's adjusted $15,703,922.91. *Glass and Glassware, Pressed and Blown:* A decrease of 1.6 per cent is shown in the preliminary $28,532,783.31, reported for February, 1957 when compared with the previous month's adjusted $28,986,860.07 figure. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,586,229.19 was reported for February, 1957. This is a decrease of 3.4 per cent when compared with the adjusted figure of $4,746,506.86 for the previous month.

Glass Container Production: Production based on figures released by the Bureau of Census was 12,956,000 gross during March, 1957. This represents an increase of 17.5 per cent from the previous month's production of 11,057,000 gross. During March, 1956, glass container production was 11,865,000 gross or 9.2 per cent under the March, 1957 figure. At the end of the first three months of 1957 glass container manufacturers have produced a preliminary total of 35,351,000 gross. This is 3.7 per cent over the 34,092,000 gross produced during the corresponding 1956 period.

Shipments of glass containers during March, 1957 were 11,358,000 gross, or an increase of 14.7 per cent from February, 1957 shipments which were 9,899,000 gross. Shipments during March, 1956 were 12,170,000 gross or 6.6 per cent over March, 1957. At the end of the first three months of 1957 shipments have reached a total of 21,569,000 gross, which is 32.9 per cent under the 32,156,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of March, 1957 were 17,318,000 gross. This is 7.5 per cent above the 16,107,000 gross on hand at the end of February, 1957 and 19.3 per cent higher than the 14,516,000 gross on hand at the end of March, 1956.

Automatic Tumbler Production: During February, 1957 production was 5,239,000 dozen. This is a gain of .2 per cent against the February, 1956 production which was 5,316,000 dozen.

Shipments during February, 1957 rose to 4,783,000 dozen. This is 3.1 per cent higher than the 4,641,000 dozen shipped during February, 1956. At the end of the twelve months period ending February 28, 1957, shipments have reached a total of 54,979,000 dozen which is 11.4 per cent lower than the 62,049,000 dozen shipped last year.

Table, Kitchen and Household Glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during February, 1957 reached 3,044,000 dozen. This is 4.5 per cent under the 3,188,000 gross of February, 1956. At the end of the twelve months period ending February 28, 1957, manufacturers had sold a total of 33,950,000 dozen, which was 8.8 per cent lower than the 37,239,000 dozen sold during the corresponding period last year.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	March, 1957
Food	1,100,000
Medicinal and Health Supplies	1,417,000
Chemical, Household and Industrial	827,000
Toiletries and Cosmetics	815,000
Beverage, Returnable	695,000
Beverage, Non-Returnable	104,000
Beer, Returnable	215,000
Beer, Non-returnable	674,000
Liquor	790,000
Wine	400,000
Sub-total (Narrow)	7,037,000

Wide Mouth Containers

Food	*2,956,000
Medicinal and Health Supplies	413,000
Chemical, Household and Industrial	197,000
Toiletries and Cosmetics	254,000
Packers' Tumblers	93,000
Dairy Products	159,000
Sub-total (Wide)	4,072,000
Total Domestic	11,109,000
Export Shipments	249,000
TOTAL SHIPMENTS	11,358,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production March, 1957	Stocks March, 1957
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,687,000	6,075,000
	Wide Mouth	*4,337,000	*5,503,000
Beverage, Returnable		928,000	1,770,000
Beverage, Non-returnable		130,000	200,000
Beer, Returnable		299,000	485,000
Beer, Non-returnable		674,000	803,000
Liquor		870,000	1,335,000
Wine		338,000	641,000
Packers' Tumblers		84,000	125,000
Dairy Products		199,000	381,000
TOTAL		*12,596,000	*17,318,000

*This figure includes Fruit Jars and Jelly Glasses.

AMERICAN POTASH ANNOUNCES TWO NEW BORON CHEMICALS

American Potash & Chemical Corporation announces the production of two new boron chemicals—boron trichloride and boron tribromide—at its Los Angeles plant. The announcement marks the first time boron tribromide has been produced on a commercial level.

Cost of boron trichloride in tonnage quantities will be at $1.60 per pound as contrasted to the present market price of $3.00 per pound, according to Daniel S. Dinsmoor, AP&CC vice president for planning and development.

Dinsmoor said the reduced price was made possible by a semi-continuous production process developed recently by AP&CC's research department. Dinsmoor said also that further price reductions are anticipated as production volume increases.

Boron trichloride, a gas, and boron tribromide, a liquid, can be used in producing elemental boron and as intermediates or raw materials for the manufacture of other boron compounds such as diborane and sodium-borohydride. Also they both can be utilized in halogenation reactions and as catalysts in certain processes.

SYLVANIA-CORNING NUCLEAR SELECTS DIRECTORS

Formation of Sylvania-Corning Nuclear Corporation and the new company's eight-man Board of Directors were announced by Sylvania Electric Products Inc. and Corning Glass Works, joint owners of the company which has been established for the purpose of expanded research, development, and production activities in the atomic energy field.

According to the joint announcement by Sylvania and Corning, the directors are: Don G. Mitchell, Sylvania chairman and president; William C. Decker, Corning president; W. Benton Harrison, Sylvania vice president-finance; Dr. William H. Armistead, vice president of Corning's research and development division; Dr. Bennett S. Ellefson, Sylvania vice president-engineering and research; Armory Houghton, Jr., manager of the components department of Corning's electrical products division; Dr. Lee L. Davenport, who will be president of Sylvania-Corning Nuclear Corporation; and Walter E. Kingston, general manager of Sylvania's atomic energy division, who will be the new company's executive vice president.

PORTER COMBINES REFRACTORY DIVISIONS

Two divisions of H. K. Porter Company, Inc., Lacledе-Christy, St. Louis, and McLain Fire Brick, Pittsburgh, have been combined under common management. To be known as the Refractories Division, it also will bring under the one management the newly acquired Mullite Refractories, Shelton, Connecticut. The Refractories Division will be headed by S. R. Gurley, Jr., as its Vice President and General Manager. W. Alfred Turner, former Vice President and General Manager of McLain Fire Brick, is now a Vice President of H. K. Porter Company, Inc., and in that capacity will act as advisor and consultant on refractory matters, reporting directly to Porter's President C. L. Holbert.

DEGNAN ASSOCIATES AND SOLON ASSOCIATES BECOME DEGNAN, SOLON AND COOK

The merger of Dan Degnan Associates and Jack Solon Associates, public relations counsellors, into a new firm to be known as Degnan, Solon and Cook was announced. Offices will be at 518 Jefferson Ave.

D. Degnan

The new firm will provide industrial, commercial and institutional clients with complete service in all phases of public relations, including publicity, promotion, employee communications, community relations, financial-stockholder relations, distributor-dealer relations and institutional advertising.

Dan Degnan Associates was founded in 1953 by Mr. Degnan, former public relations manager of Owens-Illinois Glass Company with which he had been associated for 15 years. Mr. Degnan is immediate past president of the Toledo Chapter of Public Relations Society of America.

J. Solon

Z. Cook

Jack Solon Associates was organized in 1954 by F. J. Solon, Jr., formerly vice president of Glass Fibers, Inc., in charge of advertising, trade, and public relations. Mr. Solon is president of the Advertising Club of Toledo.

Zeke Cook has been chief account executive for Dan Degnan Associates since 1954 and will continue in that capacity with the new firm. He was formerly an associate editor of *Newsweek*, account executive with Steve Hannagan Associates in New York and was public relations director for MacManus, John & Adams, Inc., Detroit advertising agency.

• Fischer & Porter Co., manufacturers of complete process instrumentation, announces a change in the organization of its research department. Nathaniel Brewer, who had held the post of Vice President, Research & Development, will now operate on a policy-making level as Vice President in Charge of Technology and chairman of the company's executive committee. To fill the vacancy F&P has brought in Alexander Greenfield as director of research, development and engineering.

New Equipment and Supplies

ALL BRASS STRAINER

Watts Regulator Company, Lawrence, Mass., announces a new low cost all brass strainer. Series 137 strainer is designed for applications requiring fine straining of air or gases and is particularly suited for keeping regulators clean. The removable strainer element is indestructible porous bronze which effectively strains out particles .004" and larger (90 microns). The strainer is available in pipe sizes ¼", ⅜", and ½" and suitable for pressures up to 500 psi.

SPEAR FLAME BURNER

Selas Corporation of America, Dresher, Pa., has available a burner which produces a sharp, spear-like heating flame used in glass blowing and working and similar fields where a high temperature flame covering a limited area is required, using any available fuel gas and air. This Series PRS burner comes in five sizes which will produce flames from two to six inches long. It combines a die-pressed kiln-fired perforated refractory screen with a heat resistant alloy pilot ring. An effectively piloted spear flame is produced, allowing wide turn-down without flame blowoff and flashback hazard. The design permits quick installation and can be mounted in any position by screwing the standard tapered pipe thread base into a prepared manifold.

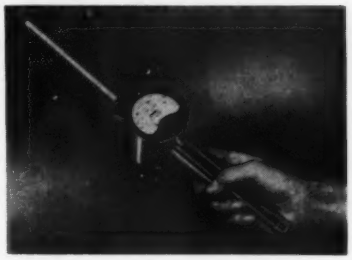
NEW CHAIN DESIGN FOR WOVEN WIRE BELTS

The Cambridge Wire Cloth Company, Cambridge, Maryland, has announced the introduction of a new design for pintle-type chain for belt installations where a chain drive is required to move heavy loads or to assure positive motion, such as through heat treating cycles or during inclined movement. The new design incorporates a heavier shoulder that provides equal bearing surfaces at both the open and closed ends of the link. Thus, distribution of bearing stresses is equalized and longer chain life may be expected.

The connecting pin is free-floating, rather than fixed as in older designs, so that wear will occur around the full 360° circumference of the pin, rather than only at localized areas. This will also contribute to longer chain life. The pin diameter has been increased to permit the carrying of heavier loads and the new design greatly increases the ease of assembly and disassembly.

Because of the completely symmetrical design of the new link, the assembled chain will operate on standard sprockets. This symmetrical design also provides longer chain life by distributing wear evenly over the entire sliding surface of each link.

NEW LOW COST SURFACE PYROMETER



Pacific Transducer Corp., 11836 W. Pico Boulevard, Los Angeles 64, California, offers a new low cost Surface Pyrometer for the instantaneous taking of temperatures of all types of surfaces. It will check surfaces as small as ¼", and its order of accuracy is said to be two per cent over the entire scale. This pyrometer affords an easy and quick method of obtaining the accurate temperature of surfaces normally very difficult to obtain without expensive equipment. The pyrometer is rugged and can be used in heavy service. It is portable and weighs only 1½ lbs. The instrument, which is balanced for constant hand use is chrome plated throughout, providing an external reflective surface that prevents the absorption of heat that would normally change the cold junction temperature. A calibrating thermometer, which is built into the unit, is positioned in the immediate vicinity of the cold junction, thereby providing a more accurate means of cold junction calibration. The thermocouple is insulated with refractory beads. The tip can be held firmly against the surfaces to be checked. The thermocouple may be easily replaced. This pyrometer comes in three temperature ranges.

PRECISION SPLITTERS FOR HIGH SAMPLING ACCURACY

Carpco Manufacturing, Inc., Jacksonville 6, Fla., has just announced an extremely accurate splitter for sampling of fine materials which segregate easily. These precision sample splitters are designed with stainless steel splitter blades, held rigidly between machined aluminum alloy blocks. Solder joint, cracks or other crevices which might tend to trap even minute quantities of material are completely eliminated.

All samplers are provided with top hoppers having a bottom discharge slot and cut-off gate. When the gate is tripped, the sample falls like a curtain over the accurately spaced stainless blades. Two deep drawn aluminum alloy sample pans with all rounded corners are supplied with each splitter. Three models are available, with chutes ⅛", ¼", and ½" in width.

NEW DRY ACID COMPOUND FOR CORROSION REMOVAL

Oakite Products, Inc., 157 Rector Street, New York 6, N. Y., has introduced Oakite Drycid, a new powdered acid material which removes rust, scale and corrosion with greater safety to metal surfaces as well as personnel. Added to water in concentrations upward of eight ounces to the gallon, Oakite Drycid is said to go into solution fast and to be useful in applications by circulation or immersion. Solutions of the compound may be used cold or for faster action, heated to 165°F. It is said to be effective in the removal of scale, scale-like deposits, rust, iron sulphides and other oxides.

CATALOGS RECEIVED

F. J. Littell Machine Company, Vacu-mation Division, 4555 Ravenswood Avenue, Chicago 40, Ill., has a brochure describing two crane suspended plate glass lifters. Model 1400V is a four-cup self-contained vertical vacuum lifter. Model 620 has two cups and a separate vacuum pump. Ask for illustrated brochure AIR-55.

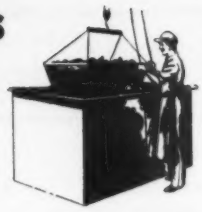
The Harshaw Chemical Company, 1945 East 97th Street, Cleveland 6, Ohio, has prepared an illustrated 20-page catalog, "Harshaw Industrial Chemicals" which contains information about Harshaw and a comprehensive listing of chemical products. The catalog is free upon request.

Minneapolis-Honeywell Regulator Company, Valve Division, Philadelphia 23, Pa., offers two new Specification Sheets giving details on single-seated and double-seated Honeywell Series 800 diaphragm control valves. Included are sizes, materials, plug characteristic curves, dimensions and a cross-section drawing of each type. These pneumatically-operated valves are applicable throughout industry for controlling the flow of liquids, gases and steam under a wide range of operating conditions. Request Specifications S810-11 and S810-12.

Kahle Engineering Company, North Bergen, N. J., has issued four new specification sheets describing new special automatic and semi-automatic machines.

These sheets describe Machine No. 1507, a new glass tubing cutting machine; Machine No. 2070, a new automatic bulb blowing machine; Machine No. 1416, a high-speed pneumatic base filling machine; and Machine No. 1708, an automatic neck sealing machine.

Clean glass molds without scraping or sandblasting!



Now, simply by soaking and rinsing, you can quickly remove heat scale, mold lubricants and carbon from steel molds used in producing bottles, jars, jugs and other items. Oakite specialized compounds do the job chemically. They work fast because of their outstanding ability to wet-out, dissolve and break up soils . . . emulsify oil, grease . . . rinse freely.

Talk to your local Oakite Technical Service Representative, or write for details to Oakite Products, Inc., 25C Rector Street, New York 6, N. Y.

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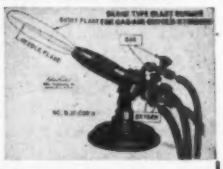


EISLER ENGINEERING CO., INC.
742 So. 13TH ST., NEWARK 3, N. J.
Charles Eisler, Jr.
President

Brockway's Moment . . .
(*Continued from page* 265)

highly complex series of electronic devices to be utilized to the greatest effectiveness.

Could all twelve founders of the company see this new Freehold plant, they would view it with a mixture of open mouthed amazement and deep personal pride. For it is unquestionably as modern, as efficient, as anything in the industry. It has, in addition, been designed to be the safest glass bottle making facility in existence.

All the development and sales ability, the wisdom and genius of the men who have followed the original Brockway directors is simply an enlargement upon early plans, early vision, and firm faith. Yet, they have been adventurous men, and would be the first to agree that the company and the industry is still a youngster.

Much remains, though, to be done by way of bringing glass to its ultimate usefulness. As research programs are carried out, new uses will be uncovered where glass will serve, as in many instances it does now—far better than any other material. The chemical inertness of glass containers is a major factor and will continue to be so during the coming generation.

Glass containers will be made stronger and lighter. And, they will be turned out in quantities that will make the wildest of today's guesstimates appear ridiculous.

Relative tensile strengths of glass quite possibly will exceed those in steel.

As to Brockway's immediate plans, they may seem to some to be the work of dreamers. That we are, and we are rather proud of the fact. Our dreams are based on a very realistic and dispassionate analysis of what the industry can expect to encounter.

We know where our industry is going, and we intend to continue our expansion and research, to have the facilities and tools on hand to be a leading contributor to the progress of our ever more invigorated and fast growing industry.

BAUSCH & LOMB INITIATES NEW OPHTHALMIC MAGAZINE

The importance of good vision in highway safety is emphasized in Volume 1, Number 1, of a new Bausch & Lomb magazine, *Today*, directed to the nation's ophthalmic professions.

The pocket-sized, 32-page publication is illustrated with full-color drawings, sketches, diagrams and photographs.

Lead article is an editorial, "Rx for Highway Safety", by George H. Phreaner, manager of B&L ophthalmic sales. It calls attention to the new book, "I Drive the Turnpikes and Survive", by Paul W. Kearney and emphasizes the role being played in several states by the new B&L Driver Testing Ortho-Rater.

The Ortho-Rater itself and the state driver testing programs where it is being used are the subjects of a six-page article.

The ophthalmic professions are given an opportunity to vote for Miss Beauty in Glasses of 1957. Four contest finalists are pictured and a postcard ballot is enclosed. Other half of a tear-off double card gives the nation's optometrists, ophthalmologists and opticians an easy way to ask for additional information on five different ophthalmic materials shown in the magazine.

Inventions and Inventors . . .
(*Continued from page* 278)

in an unobstructed position opposite and facing a surface of the support body to be coated and is heated by said heating element to cause said material to be evaporated and deposited on said surface as a coating after the creation of a suitable vacuum.

By the use of a plurality of heating elements, each of which is loaded with a predetermined weight of the same material and arranged in predetermined grid fashion in a plane, parallel to and equally spaced from the support body surface, it is possible to secure a coating of uniform thickness over all of said surface by the firing of all of said heating elements. Many uses have arisen for articles of glass or other refractive material having multiple coatings or films on a surface such as, for example, dichroic and beam splitting mirrors, filters or the like.

There were 13 claims and the following references were cited in this patent: 2,239,452, Williams et al., Apr. 22, 1941; 2,384,209, Sukumlyn, Sept. 4, 1945; 2,430,994, Reynolds, Nov. 18, 1947; 2,532,971, Van Leer et al., Dec. 5, 1950; 2,539,149, Miller, Jan. 23, 1951 and 2,586,752, Weber et al., Feb. 19, 1952.

• The appointment of J. L. Collins as chief mechanical engineer at Corning Glass Works was announced by A. W. Weber, director of the company's Manufacturing and Engineering Staff Division.

In his new position, Mr. Collins will be responsible for all of the division's mechanical development work. He has been manager of the Machine Design Dept. since 1955.

LEWIS AND DUNDAS NAMED GCMI TRUSTEES

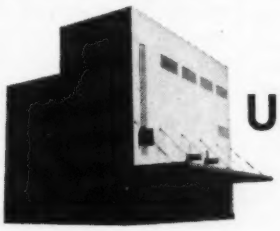
Howard G. Lewis and Fred N. Dundas were elected to the board of trustees of the Glass Container Manufacturers Institute, Inc., at a recent meeting of the board, according to an announcement made by Victor L. Hall, GCMI's general manager.

F. N. Dundas

H. G. Lewis

Mr. Lewis is vice president of the Hazel-Atlas Glass Division of Continental Can Company, Inc., headquarters of which are in Wheeling, West Virginia.

Mr. Dundas is executive vice president of Dominion Glass Company, Limited, headquarters of which are in Montreal.

THIS IS THE  ULTRA-MODERN PLANT

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Potassium Carbonate • Chloroform
Snowflake® Crystals • Caustic Potash
Sodium Nitrite • Sodium Bicarbonate
Ammonium Chloride • Methyl Chloride
Hydrogen Peroxide • Methylene Chloride
Soda Ash • Chlorine • Monochlorobenzene
Carbon Tetrachloride • Cleaning Compounds
Para-dichlorobenzene • Ortho-dichlorobenzene
Ammonium Bicarbonate

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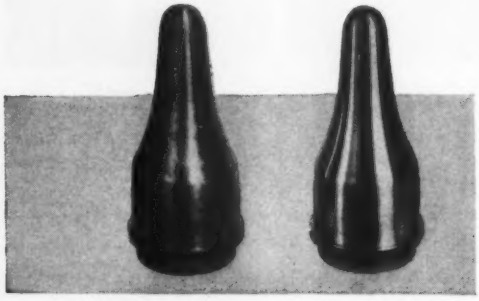
THERMOSPRAY coated mold plungers give 8 times longer service life

Important savings are being made in production down-time and replacement-part costs on equipment subject to heat and abrasion. Typical of these are mold plungers like those shown here which are being THERMOSPRAY coated by glass manufacturers for protection against heat corrosion. Other advantages include improved product quality, with better finish on glass parts. Longer production runs are feasible without dismantling machines.



Before (left) and after (right) coating with METCO *ThermoSpray* Process. Users report coated plungers last average of 8 times longer than uncoated. Parts finish is improved, production down-time reduced.

The new METCO THERMOSPRAY Process consists of spraying specially developed alloys in powder form with the METCO THERMOSPRAY GUN. These alloys are of the nickel-chrome-boron type and are self-fluxing. No compressed air is required. Coating hardnesses range from Rc 30 (machineable) to Rc 65, depending on the specific THERMOSPRAY alloy used; will even outwear hardened steels from 3 to 10 times. Spraying speeds are higher – 8 to 10 lbs. per hour – and deposit efficiency far greater (up to 97%) – than with any other type of available equipment.

Application of these materials in powder form permits close control of the amount applied and leaves a comparatively smooth surface that requires a minimum of finishing compared to other methods of application.

Free bulletin—write today for Bulletin 126 which illustrates and describes the METCO ThermoSpray Process or ask for a call by a full-time, company-trained Metco Field Engineer in your territory.

The following names are the property of Metallizing Engineering Co., Inc.: METCO, ThermoSpray.*

**Reg. U. S. Pat. Off.*

Metallizing Engineering Co., Inc.

1185 Prospect Ave., Westbury, L. I., New York · cable: METCO

In Great Britain: Telephone: EDGEWOOD 4-1300

METALLIZING EQUIPMENT COMPANY, LTD.—Chobham near Woking, England

Research Digest . . .

(*Continued from page* 277)

the moment of the opening of the bubble until its diameter was measured.

The following analytical procedure was used to deal with the gas bubble liberated under the microscope: the gas bubble was sucked out from the glycerine which fills the space between the two lenses, by means of a micropipette, and was transferred to the first of a series of special vessels containing absorbents for CO_2, O_2, CO, and H_2. The gas remaining unabsorbed was considered to be nitrogen. The microburette was mounted in a special holder, which could be moved in the three basic directions. The operation of bubble transfer from between the lenses was carried out under constant observation through the microscope, the bubble and the tip of the micropipette being kept in the field of vision. The following solutions were used in the absorbing vessels:

CO_2 absorption: 4 gm. KOH in 10 ml. glycerine

$CO_2 + O_2$ absorption: 1:1 mixture of the KOH solution and of pyrogallol solution (1 gm. pyrogallol in 50 ml. H_2O+2 ml. HNO_3).

CO absorption: Ammoniacal solution of cuprous chloride.

H_2 absorption: Colloidal palladium.

CO and H_2 were never found by the authors in the bubbles in glass; thus in practice it was sufficient to determine only CO_2 and O_2.

The accuracy of the method depended on the accuracy of the measurement of the bubble diameter, and on the speed of CO_2 absorption in glycerine. The bubble diameter was measured with an accuracy of $\pm 1.0\mu$. For the smallest bubbles, of 20μ diameter, the corresponding error was 15 per cent; for bubbles of 40-60μ diameter, which are the most common, it was 5-6 per cent.

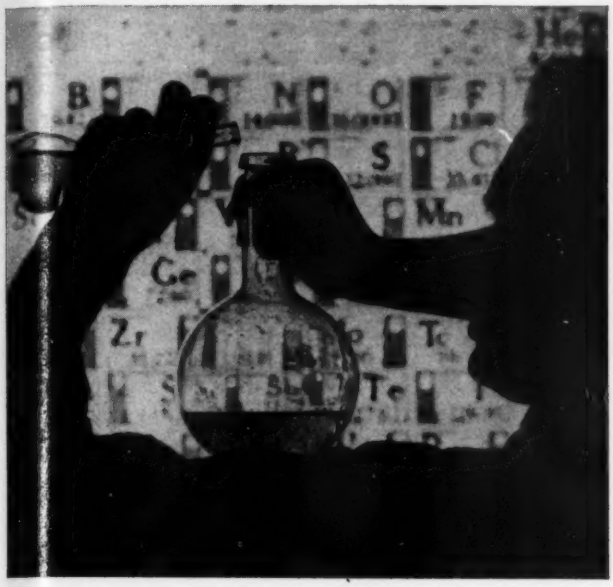
R. F. EVANS, DIAMOND CHAIRMAN ELECTED TO IONICS' BOARD

Raymond F. Evans, Chairman and Chief Executive Officer of Diamond Alkali Company, Cleveland, Ohio, was elected to the Board of Directors of Ionics, Incorporated, at the annual stockholders meeting.

Diamond and Ionics recently established a research partnership through which the Cambridge company, specialists in ion exchange and ion transfer, will conduct substantial research for Diamond, a leading producer of basic chemicals for industry and agriculture. Ionics is a major producer of water demineralization equipment employing the electric membrane process pioneered by the company.

Mr. Evans joined Diamond Alkali as a production worker following his graduation in chemistry from Princeton University in 1931. He later was transferred into research, where he spearheaded Diamond's present extensive, growing research and development program. During World War II he served as president of Diamond Magnesium Company which the parent concern operated for the government. He served as vice president and general manager of Diamond's Painesville, Ohio, plant prior to his appointment as executive vice president in 1946. He became president in 1947 and chairman in 1954.

FROM VITRO —another example of research at work for you...



THE FINEST COLORS EVER DEVELOPED for metal-screen or silk-screen applications

These "Hi-Glo" colors by Vitro offer a number of important advantages provided by no other brand. With them you get a fine degree of decorative detail never before thought possible and they give excellent results when used for screening even very small letters.

As many manufacturers already know, these glass colors are very economical to use because they're formulated to give unusually good coverage and can be fired to a high gloss at temperatures as low as 1050°, *without any danger of blistering.*

In addition, Vitro's "Hi-Glo" line offers maximum resistance to acids and alkalis. They're available in a wide range of colors and either in thermoplastic or cold screening oils. We'll be glad to supply full information on these and other Vitro glass colors—without obligation.

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in
RAW MATERIALS?

Yes, often there are hidden costs in raw materials and Calumite offers advantages which help to eliminate them.

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- **markedly reduced volatile attack and batch carry-out.**
- **longer checker life and furnace efficiency.**

Calumite, in delivering these "extras", helps to eliminate the hidden costs in raw materials.

The Calumite Co.
HAMILTON, OHIO

SECOND SYMPOSIUM OF AMERICAN SCIENTIFIC GLASSBLOWERS SOCIETY

The Second Symposium on the Art of Glassblowing will be held May 30-June first at the Corning Glass Center and the Baron Steuben Hotel in Corning, New York. Sponsored by the American Scientific Glassblowers Society in cooperation with Corning Glass Works, the Symposium will have as its topic "Technology and Manipulation of Glass".

The program is as follows:

Thursday, May 30th

4:00-5:00 P.M. Registration, Lobby, Baron Steuben Hotel.
5:00-7:00 P.M. Dinner, Baron Steuben Hotel.
7:30 P.M. Business Meeting, (members only), Small Auditorium, Corning Glass Center.

Friday, May 31

8:30-9:45 A.M. Registration, Lobby, Baron Steuben Hotel.
10:00 A.M. "Welcome" by Olaf M. Loytty, Large Auditorium, Corning Glass Center.
10:15 A.M. "Glass Magic" and "Glass in Atomic Energy" by Dr. Wm. H. Shaver, Manager, Atomic Energy Dept. and Consumer Product Development Dept., Corning Glass Works.
11:15 A.M. "Glass—An Integral Component of Heating Devices" by Everett H. Kelm, Project Group Supervisor, Product Engineering Dept., Technical Product Division, Corning Glass Works.
12:30 P.M. Luncheon and Photograph, Large Auditorium, Corning Glass Center.
2:00 P.M. "New Concepts in Glass" by Dr. John H. Munier, Manager, General Product Development Dept., Research and Development Division, Corning Glass Works.
3:00 P.M. "A Treatise on Modern Glass Fabrication" by Vincent C. DeMaria, Supervisor, Experimental Glass Shop, Sylvania Electric Products.
4:00 P.M. "The Varieties of Glass" by Oscar H. Grauer, Director of Glass Research, Fischer and Porter Co.
4:30-5:30 P.M. Movies, "Glass for Science" and "Glass and You", Large Auditorium.
7:00 P.M. Dinner, Large Auditorium, Corning Glass Works.

Saturday, June 1, 1957

9:30 A.M. "Glass to Metal Seals" by Charles Cassidy, Laboratory Supervisor of Glassblowing, Westinghouse Research Labs.
10:30 A.M. Open Discussion Period, J. Allen Alexander presiding.
12:30 P.M. Luncheon, Baron Steuben Hotel.

• The appointment of John V. James as manager of budgets and accounting procedures at Corning Glass Works was announced by George D. Macbeth, vice president and controller. He succeeds Charles L. Yale, who has been appointed controller of Corhart Refractories Company, Inc., Louisville, Ky., a Corning Glass Works subsidiary.

MORE areas in MORE tanks use MONOFRAX® refractories

. . . uses MONOFRAX M fused cast refractories for throat, doghouse, backwall, bridgewall and part of tank sidewalls—because this material is highly resistant to even the most corrosive glasses. MONOFRAX H, a one phase material which does not tend to spall or flake into the molten bath, is used for tuckstones, port bottoms, port jambs, port arches (note close-fitting joints), burner blocks, bridgewall covers, shadow wall, doghouse mantle and peephole blocks.

Your choice of refractories for each area of your tank can determine the quality of your glass and the efficiency of your operation.

The extreme purity of MONOFRAX M and H refractories, plus the almost complete absence of a glassy phase, safeguard glass quality by helping to reduce seeds, stones and cords. That's because MONOFRAX blocks consist of over 98% alumina with less than 0.2% impurities and next-to-no interstitial glass.

MONOFRAX shapes also give tight-fitting, more durable structures. They're carefully made to closer tolerances, give exceptional resistance to heat, heat shock and corrosion to prolong tank life.

Look into MONOFRAX refractories to lengthen the life of more areas of your tank—above the glass line and below—and to improve glass quality. Just write—

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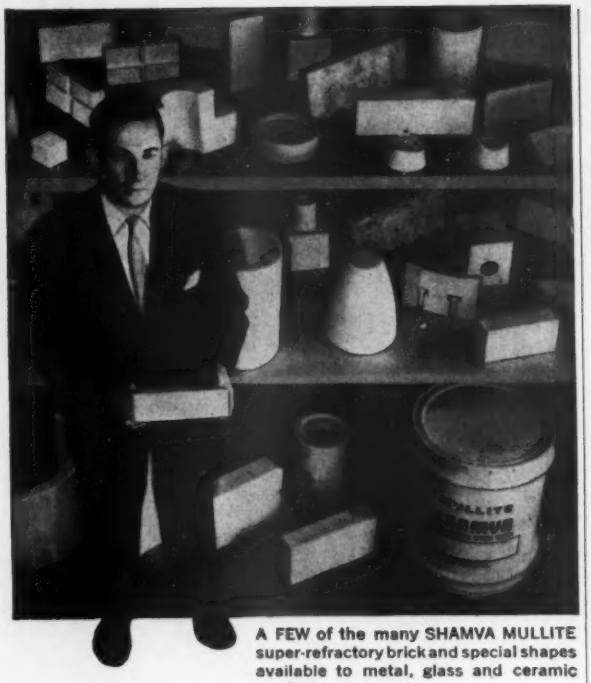

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HKP MULLITE WORKS REFRACTORIES DIVISION H. K. PORTER COMPANY, INC.

COBALT DEVELOPMENT INSTITUTE HOLDS GENERAL ASSEMBLY

The first General Assembly of the Cobalt Development Institute, created on January 16, was recently held in Brussels, Belgium. Officers elected were: Mr. Robiliart (Administrateur délégué of Union Minière du Haut-Katanga), chairman of the Institute; E. C. Baring (Director of the Rhokana Corporation, Ltd.), vice chairman; and C. Piedboeuf (Chairman of the Centre d'Information du Cobalt), vice chairman.

The Cobalt Development Institute is a technical and scientific organization, made up of the world's major cobalt producers. Its object is to improve the existing uses of cobalt and to develop new ones. The Belgian limited liability company "Centre d'Information du Cobalt" has been entrusted with the execution of the Institute's program. The Centre is located in Brussels, at 35, Rue des Colonies, and is represented in the United States by the "Cobalt Information Center" at the Battelle Memorial Institute in Columbus, Ohio. A research program of fundamental studies is being sponsored and, through the dissemination of technical data, these informational centers assist users and potential users of cobalt.

According to the Cobalt Development Institute, cobalt reserves and production capacities are now sufficient to give consumers assurance of regular and abundant supply, enabling them to undertake the manufacture of new products using cobalt.

EUROPEAN CHEMICAL ENGINEERING CONGRESS SCHEDULED FOR 1958

The European Congress of Chemical Engineering 1958, which will take place from May 31 to June 8, 1958 in Frankfurt am Main in conjunction with the ACHEMA Congress 1958, will include the following congresses and meetings: ACHEMA 1958, 12th Exhibition and Congress of Chemical Engineering organized by DECHEMA; the Second Congress of the European Federation of Chemical Engineering, which will commence in Brussels on May 28 and 29 and will be continued at Frankfort am Main from May 31 to June 8; the Second Congress of the European Federation of Corrosion; the Special Meeting and Lectures of the Gesellschaft Deutscher Chemiker, and the Annual Meeting 1958 of DECHEMA Deutsche Gesellschaft für chemisches Apparatewesen.

The 16-page Invitation Brochure is now ready. It is published in English, French, German, Italian and Spanish and copies may be obtained free of charge from DECHEMA, Frankfurt am Main 7, Postfach.

FISHER SCIENTIFIC PURCHASES MACHLETT

Fisher Scientific, America's largest manufacturer-distributor of laboratory instruments, apparatus and reagent chemicals, has purchased the laboratory apparatus and supply business of E. Machlett & Son, it was announced by Machlett president Richard Schnier. Machlett, producer of the first commercial Warburg apparatus for blood gas and tissue metabolism studies, is noted for its glassblowing facilities, as well as its export and medical-clinical departments. These will be supplemented by Fisher's research and manufacturing facilities and extensive inventories.

Viking Glass Company replaces one Laclede-Christy melting pot with another. For good reason—Laclede-Christy pot was used 664 days before replacement.

664 days production from one melting pot

A record? It certainly was. But this 664-day melting pot performance at Viking Glass Company is typical of the advantages obtained from Laclede-Christy refractories. It also explains why Laclede's glass industry customers come back for more.

Why? One reason is Laclede's quality control—maintaining exact ingredients and product uniformity. Another is Laclede's constant research for new materials and methods to produce longer-lasting, more efficient refractories.

Long refractory life, low operating costs and service to customers is Laclede's way of earning your glass refractory business.

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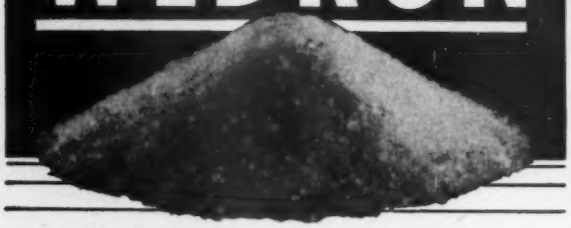

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RAPID DETERMINATION OF LENS DISTORTION

A study by the National Bureau of Standards has shown that the distortion in the image produced by a projection lens can be readily calculated as a linear function of the magnification. A. A. Magill of the Bureau's optical instruments laboratory has developed a simple equation which expresses the distortion at any magnification in terms of the magnification and of two previously measured distortions.[1] This equation should be particularly valuable in the field of photogrammetry, where high precision is required in order to produce accurate maps from serial photographs.

The distortion produced by a lens when used for copying or projection varies with the magnification at which it is used. It has been customary, when high precision work is involved, to measure distortion in the laboratory for each object-to-image ratio employed. However, when the equation developed at NBS is used, distortion need be measured at only two magnifications.

The two distortions used are those obtained with parallel light incident, in turn, on the front and on the back of the lens. These distortion values not only require the simplest experimental setup but also have special significance in being determined at the limits of real image formation.

Specifically, if D_0 represents the distortion obtained with parallel light incident on one side of the lens (zero magnification) and D_{00} the distortion obtained with parallel light incident on the other, then the distortion D_m at any finite magnification is given by $D_m = D_0 - mD_{00}$.

The definition of distortion used for the Bureau's equation is simply the lateral displacement of the image from its theoretical distortion-free position. A relation between distortion and magnification previously developed by E. Wandersleb[2] is hyperbolic since he defines distortion as the ratio of the displacement of the image to the distance between the distortion-free position and the axis of the lens.

The Bureau has verified the linear equation for three commonly used types of symmetrical objectives at relative apertures of f/22. It was concluded that under certain limitations the same type of computation may be carried out with other kinds of lenses.

(1) For further technical details, see Variation in Distortion with Magnification, by A. A. Magill, J. Research NBS, *54*, 135 (1955) RP 2574.
(2) E. Wandersleb, Uber die Verzeichnungs Fehler Photographischer Objectiv, Z. Instrumentenk. *27*, 33-37, 75-85 (1907). The equation is also used in many optical texts.

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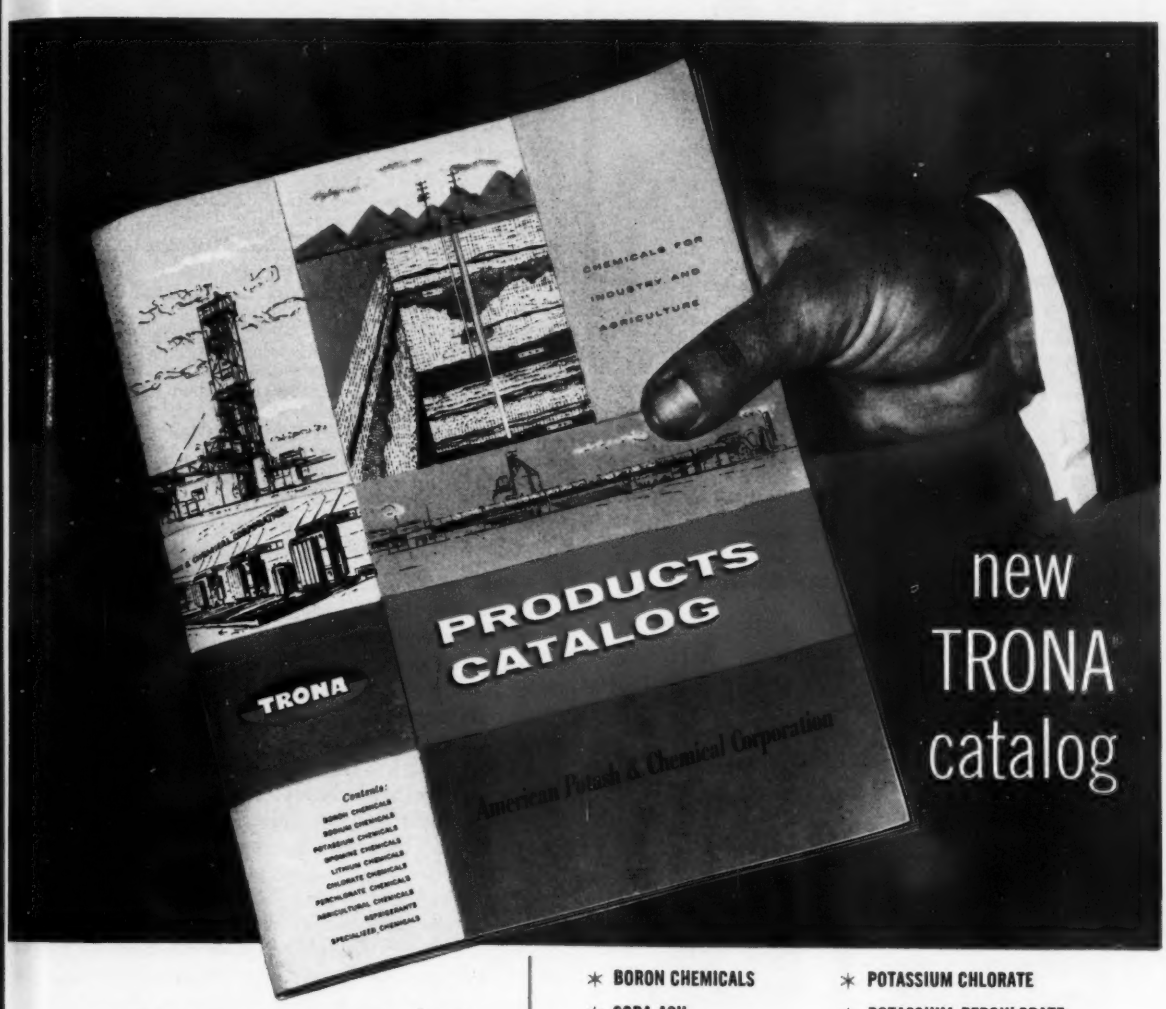

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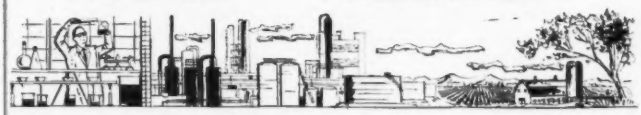

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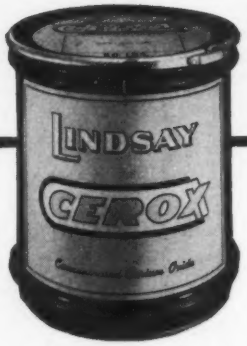

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LANCASTER NAME CHANGE RESULT OF DIVERSIFICATION

Widely expanded application for its products and services, plus the recent acquisition of Indiana Glass Company, Dunkirk, Indiana, has prompted The Lancaster Lens Company, Lancaster, Ohio, manufacturer of custom-made glass parts for commercial and industrial use, to change its name to Lancaster Glass Corporation. The Indiana plant will be operated as a Consumer Products Division.

Originally a producer of commercial and industrial optics, Lancaster has diversified its manufacturing operations in recent years to meet a steadily increasing demand for custom-made glass components.

Because Lancaster's know-how and facilities are now devoted to the manufacture of glass parts for companies in many different fields, including the appliance, TV-electronics, automotive, aircraft, photographic, lighting, instrumentation and signaling industries, the new name is expected to give a more accurate definition of Lancaster's current manufacturing activities, according to Robert K. Fox, president of the 46-year-old firm.

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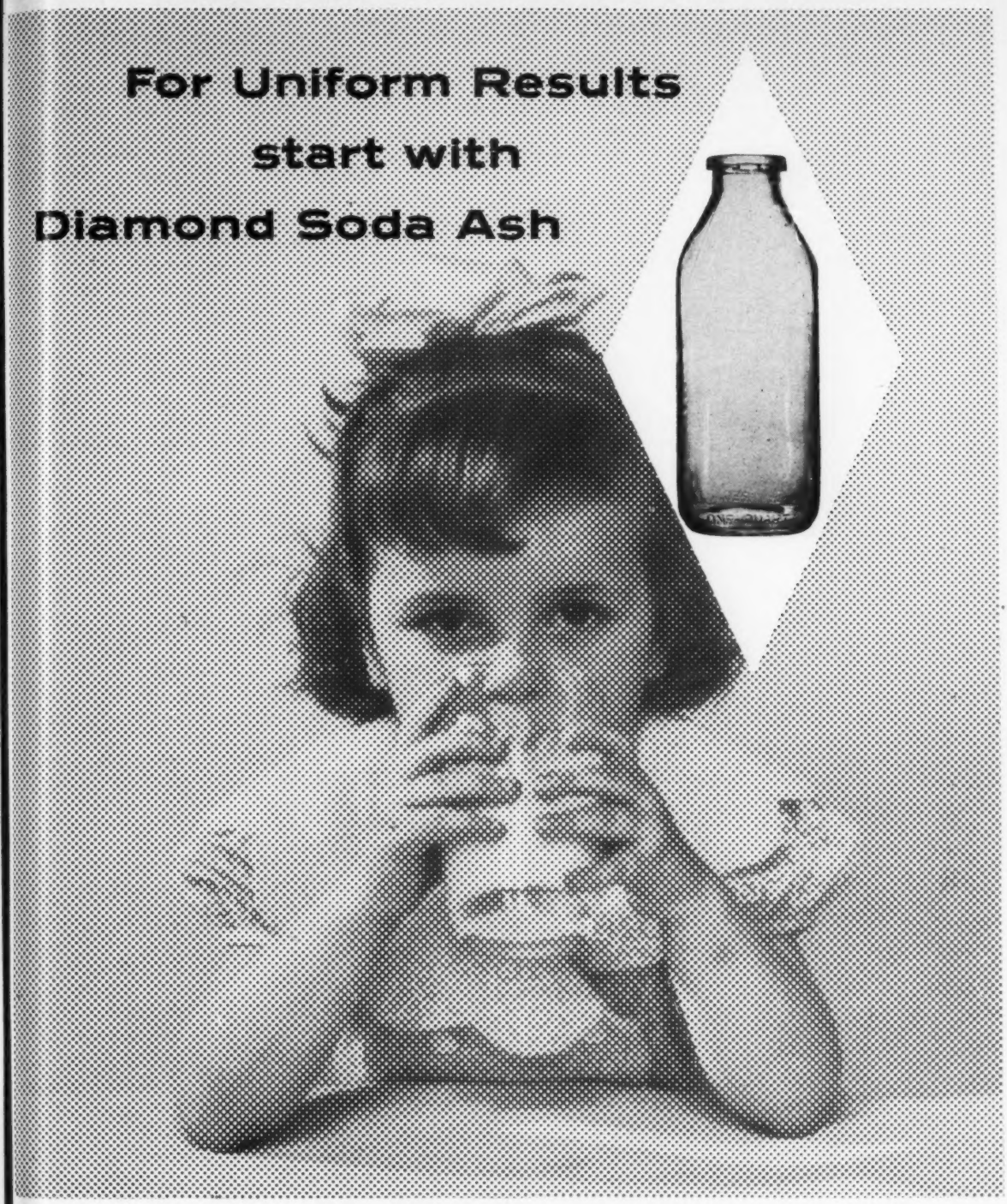

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